The Welding Engineer

Founded by L. B. Mackenzie, 1916

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$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. Reg. U. S. Pat. Office $4.00 per year abroad

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Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Purox Co.
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Carbic Mfg. Co.
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International Oxygen Co.
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K-G Welding & Cutting Co.
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Modern Engineering Co.
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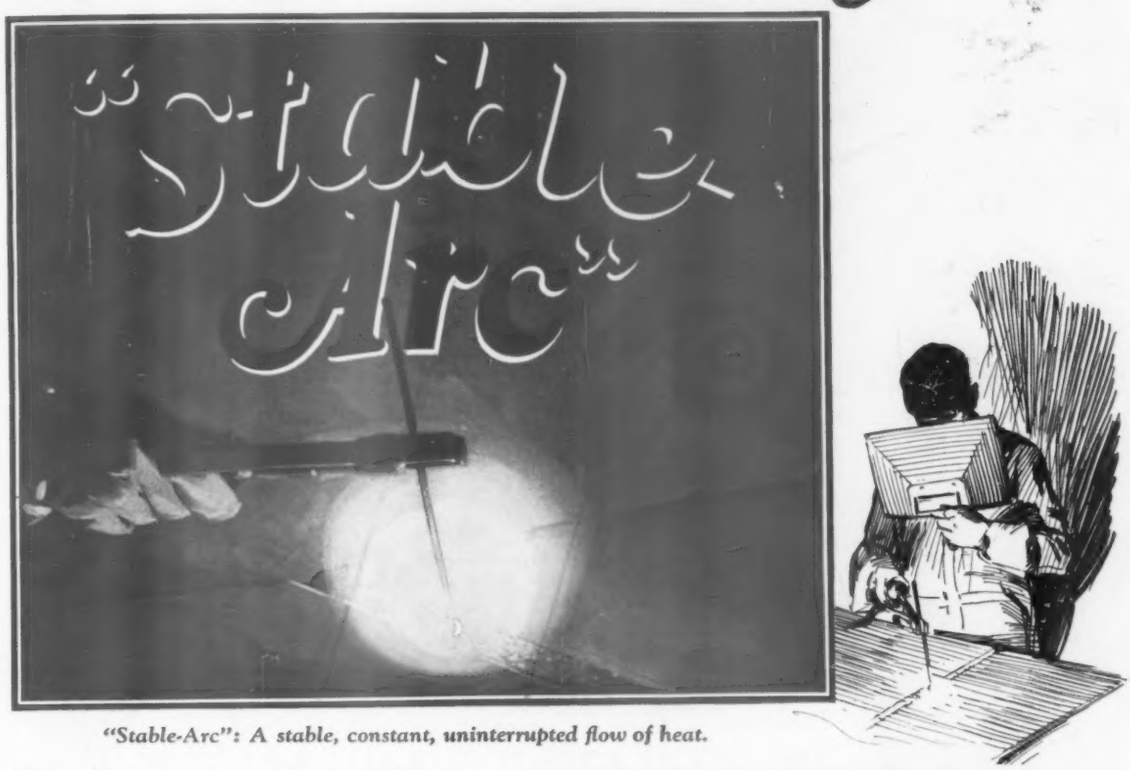

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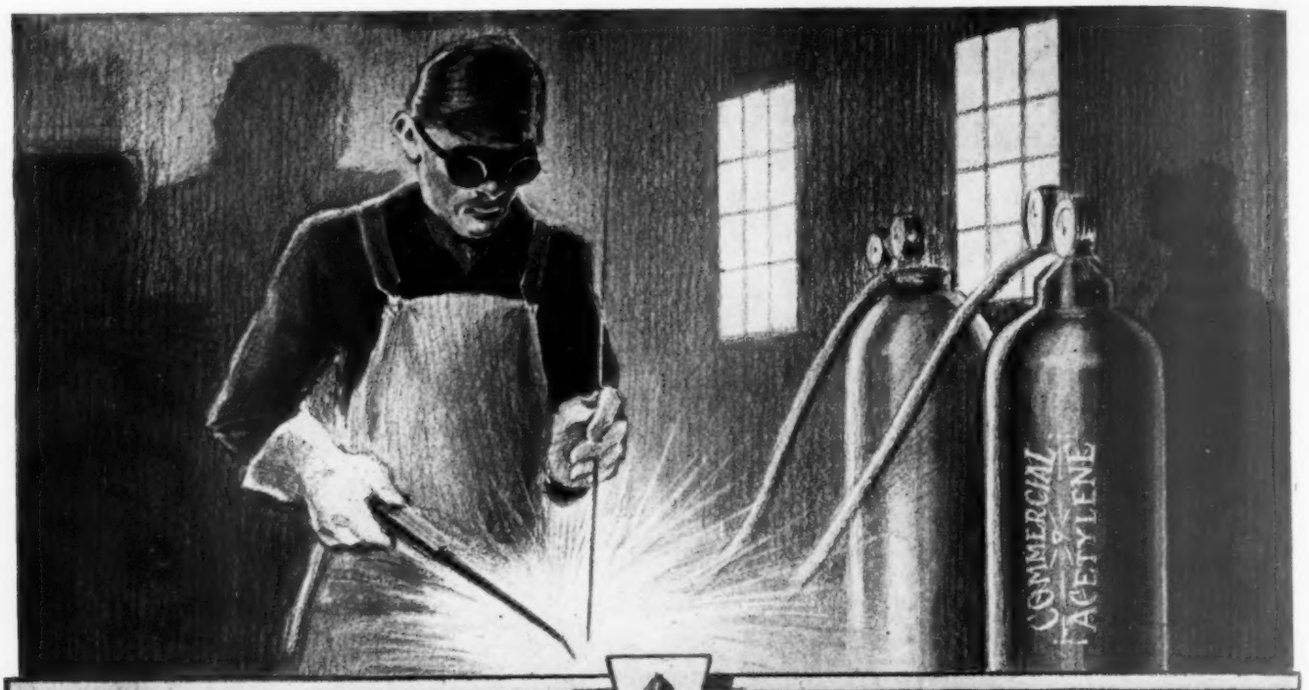

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The BURCO STA-SET Regulator is constructed along distinctly new lines. It has many advantages.

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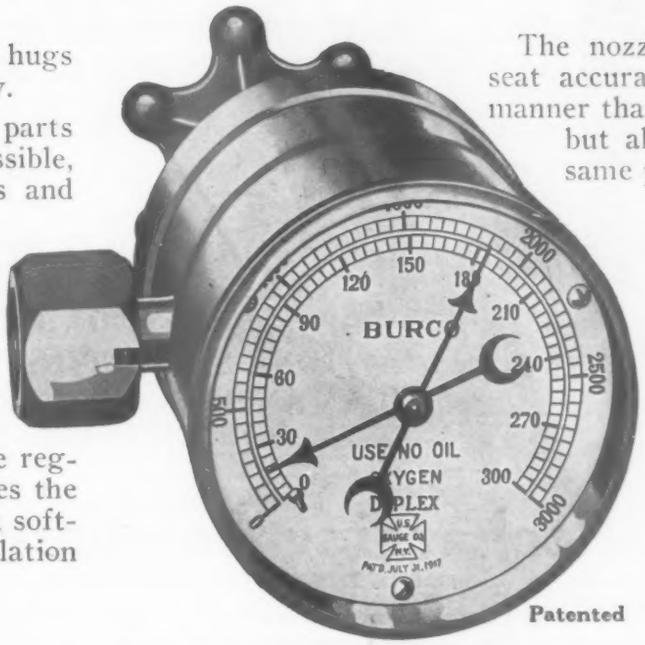
Internal working parts are quickly accessible, simplifying repairs and assembly.

The connecting nut to the oxygen cylinder is removable without unsweating the nipple.

It is a lever type regulator, which makes the spring action much softer and the regulation more accurate.

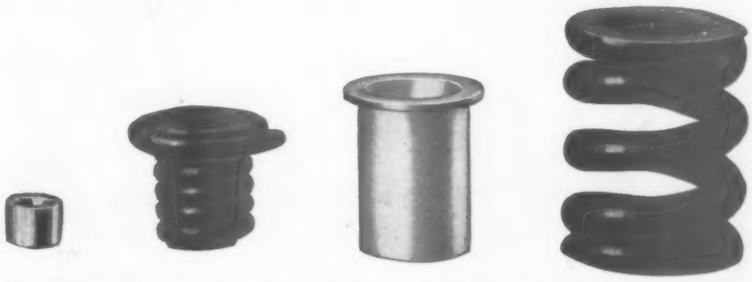


The nozzle is large and the seat accurately guided in such manner that it cannot be turned but always reseats in the same position.

In operation this regulator delivers a full volume of gas under accurate regulation, with less fluctuation than is normally found in other regulators.

The large nozzle prevents freezing and accurate regulation means better welding at lower costs.

BURCO STA-SET REGULATOR NO. 3150



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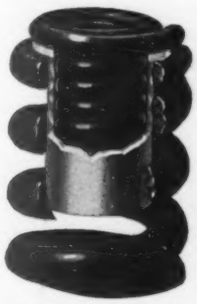

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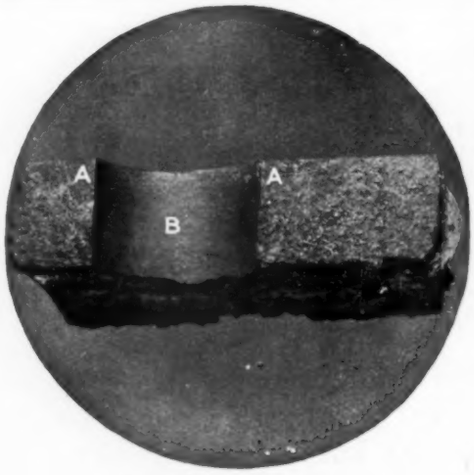

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"A-A" is the welded portion. "B" section of hole drilled through weld showing uniformity of metal.

Convince yourself

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IRON, STEEL, BRASS OR BRONZE

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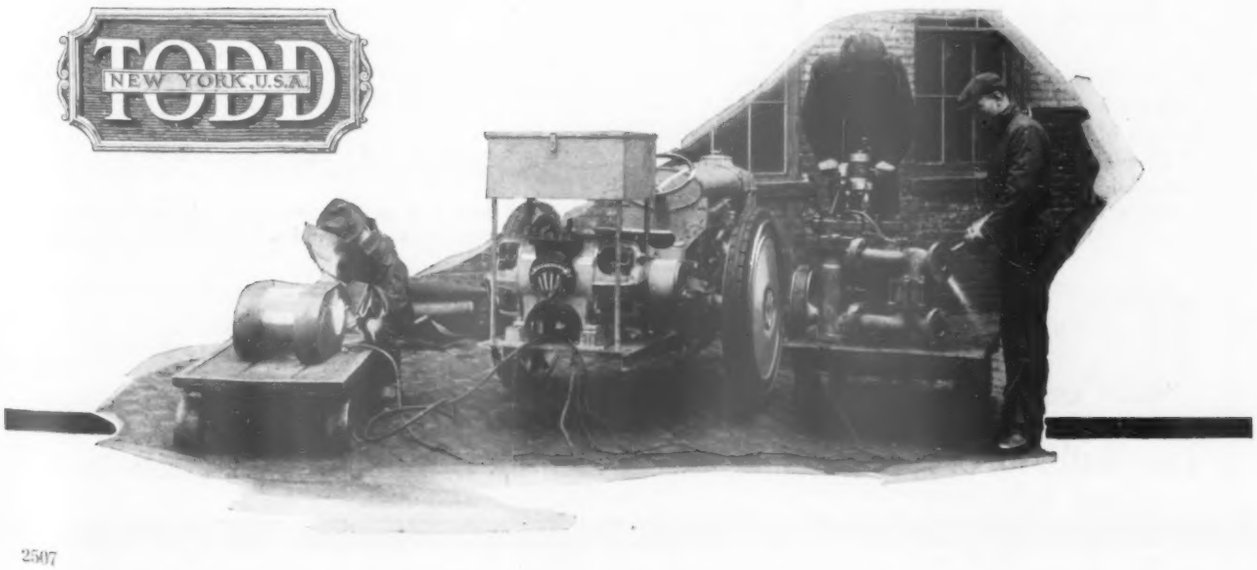

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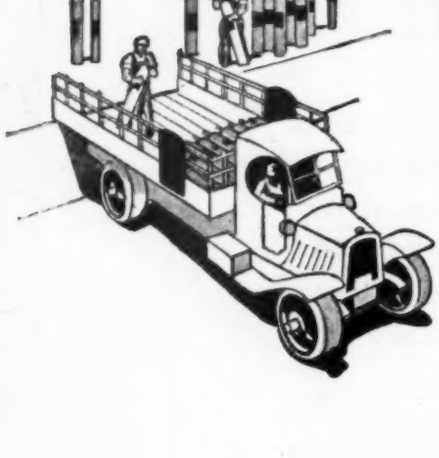

YOUR REQUEST for Linde Service will not always bring you a man. Problems similar to yours may have been solved so frequently by Linde that the solutions have been compiled into a book or covered in a magazine article.

These books and magazines, which are a part of Linde Process Service, will not answer all of your questions. But they will answer many of them.

Linde Process Service will not do your work for you. Yet it may be necessary for a Linde Service operator to use a blowpipe to demonstrate the correct practice.

Linde Process Service will not train your operators. But it will help you to teach them and keep them informed on the latest practices.

Linde Process Service will not run your shop. But it will help you do your welding and cutting in accordance with the best shop methods.

Linde Process Service will not do your engineering. But Linde engineers can be of assistance to your own engineering department on all phases of welding and cutting.

Finally, Linde Process Service will not be perfect. But it is the best answer today to problems which arise when the oxy-acetylene process is used or contemplated. Furthermore, successful service in each specific case makes Linde Process Service better and more helpful to all Linde customers.

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Prospects for Educational Work

Applications of Fusion Welding Have Advanced More Rapidly Than Means of Educating Those Most Interested

ALTHOUGH the problems presented in seeking a further advancement of the oxy-acetylene and electric arc welding processes are not radically different from those encountered in other recently perfected industries, it is not possible to go outside of the field and get much help because pretty nearly everybody else seems to be in the same boat. It is not at all uncommon to find that there is a general lack of understanding of the real possibilities of the processes, because the progress of practical application and successful application has proceeded faster than the education of the public has proceeded. At almost any gathering of men who are directly or indirectly interested in welding there will be heard from all sides the complaint that progress is being hampered and the growth of the manufacturing end of the industry slowed up because so many features of the work are so little understood by those who are in a position to profit through more extensive use of one process or another.

As it is a matter of giving everyone concerned the information which would result in building up their confidence in welding, it is safe to say that one of the most important needs of the welding industry today is for more educational work. If the unworked possibilities along educational lines are not considered in detail, there are many who will say that plenty of educational work has been done. Perhaps it would be more accurate to say that a great deal of the educational work has been done but there is no doubt that a lot of this would have been more effective if more attention had been paid to reaching the right people in the right way. At any rate, the often expressed impatience at delay in getting welding accepted as the universal method of joining metals is indication enough that the whole industry will welcome every opportunity to increase its activity; and since there is a general agreement that increased activity will have to come as the result of better educational work, a more careful study of educational possibilities is certainly in order.

It is natural enough to associate the educational idea with schools, but schools are only an incident in the work which can be done to good advantage. At present, we have about one hundred schools in this country who teach welding in one form or another, outside of the public manual training schools who are said to be giving some attention to the subject in different localities. The question of welding schools will, of course, come up whenever educational work is discussed because it is known that there are so many of them and they are very easily reached. According to the best information obtainable only a very few of the instructors in these schools are really working along the right lines. The man who says that welding schools are doing more harm than good usually means to say that when we compare all of the good work done with all of the indifferent or actually poor work there seems to be a decided lack of proper fundamental training. At the same time, there are several schools where welding instruction is in the hands of capable instructors and where young men are turned out regularly with a good fundamental knowledge of the process. (In speaking of welding schools it is generally understood that reference is made to gas welding because only a few schools have made any attempt to teach the electric arc process.) It isn't necessary to urge the discontinuance of the incompetent schools. There has been a good investment made here in apparatus and facilities are available for giving instruction. Also, the difference between good work and poor work is comparatively slight and it should not be a difficult matter to raise the standard of work to a considerable degree. To do this means that in the first place somebody has got to have the courage to criticize the work which is of poor quality. Then the instructors themselves will have to have the courage to handle their students in a sensible manner, insisting upon work being repeated until every fundamental principle has been grasped and frankly telling the students who show little promise that they should not continue the work. A student who cannot stand severe criticism of his work in school and who cannot be happy about repeating one exercise over and over again until he absolutely masters the correct procedure is not fit to be a welder, and just as soon as he goes on the pay roll as a welder he starts to act as a drag on the progress of the industry. If the welding instructors in all of our schools would subscribe to this principle and live up to it, it is pretty certain that an increased satisfaction with the work of all of the schools would almost immediately be noticeable. It is not necessary to dwell further upon the possibilities for effective working with the schools; a number of practical suggestions have already been made and a good deal of constructive work is already in progress.

Improvement in the present results, increased satisfaction with all of the welding processes and a desire to extend their applications can be furthered by providing or directing some educational activity toward the managerial end of the industry. Plant managers, superintendents and foremen in the places where welding is being done, either on a large scale or a small scale, are taking an increased interest in the subject and we are finding more and more of them who have given it such careful study that they have much in the way of real useful information to exchange with each other. There are still plenty of them who, if they do not actually want a certain amount of information, certainly need it, if they are going to become boosters for the cause. Here we have something entirely different from the matter of training operators. We are dealing with a group whom we are anxious to assist in securing the best possible results. To that end it isn't essential that they be trained as operators but they they do need a big fund of practical suggestions on such subjects as the selection of operators, how to determine their efficiency and value by watching them at work and to grade them and check the uniformity of their operations by the use of test pieces and by the examination of the finished work, how to select welding materials for particular classes of work, how to increase the efficiency of a process by proper design of parts to be welded together, how to organize welding departments, and how to provide training programs adapted to their own work.

Assuming that an extensive program of education along the above lines was justified, it is well to keep in mind that there are valuable lessons to be learned from some of the well known failures. In the application of a welding process, particularly since these failures have kept many people from experimenting with a welding process through fear of a similar failure and a lack of understanding of the cause. Here is a typical example. In the course of a conversation early this year a large manufacturer made the following remarks. "The boosters for the welding processes promise too much. Here is a reprint of a paper describing a very im-

portant welding job which gives a very glowing account of how some of you fellows accomplished what was considered nearly impossible. That is all very well, but we have since had information that the job was a total failure and no more of this work is being attempted." What this man did not know, until he was told, was that the job itself was not a failure. Just as far as it was carried on by competent workmen under the direction of men who understood the process it was highly successful, but the customer in this case jumped to the conclusion that welding was very simple and could be entrusted to the supervision of any foreman who knew how to handle labor. A number of good men left the job in disgust. Unskilled labor was put to work and supervision entrusted to men who didn't know a good weld from a rosebush; and the result was just what might be expected. More attention should be paid to these failures. They should be analyzed for the benefit of new users and held up as horrible examples of what not to do. Welding is an efficient process, it saves time, saves labor, saves materials and gives better joints. There is enough merit in welding proprly applied to justify its further application in a great many industries so it is not necessary to encourage any economy in its application which would tend to detract from the ultimate satisfaction.

The incident mentioned above is a sufficient illustration of the value of careful selection of workmen. No matter which process is being used and no matter what kind of work is being done, it is never difficult to show by actual demonstration that a good workman at a higher wage is a better labor investment than a cheaper inefficient workman; but the matter of low first cost is a hard argument to meet in this country, so this will be one of the hardest lessons to prepare and drive home. At the same time it is one of the most valuable because it is out of the question to get the best results from an indifferent or mediocre class of operators; and a real good workman will not spend much time in a trade which does not pay well for good work. It is too easy to learn another trade. Under present conditions the grading of welding operators can probably be done to the best advantage by the employers, but no matter how this is accomplished it is going to be worth while to insist upon the desirability of securing good operators and making it worth their while to do the right kind of work.

Another group who are easy to reach and who show a constantly increasing desire for knowledge of welding in its usefulness are the engineers in various industries. There are a great many industrial associations who already have included papers on welding in one or more of their convention programs and in all cases where such papers have been presented there have been present quite a large group to whom welding was practically a new subject. There is a field here for educational work of a very effective nature. To be most effective it must be free from commercialism. It must also take into account the fact that there are some staunch doubters in the audience whose views may be changed by proper reference to the cause of such failures as have been given wide publicity in the past. In this sort of educational work it is important to make very plain that there is a difference between good welding and bad welding; that it is only good welding which is efficient and worth while and that it is always possible to provide facilities for good welding.

The welding processes have almost had to fight their own battles single handed with the various trades. The process of making welding fit in comfortably some of the organized crafts has been a rather haphazard affair and the results have been far from uniform. However, in some cases there have been very satisfactory solutions of special problems of this sort. It would not be very difficult to search out and make a study of some of these cases and have some practical suggestions available for handling such problems as they come up in the future.

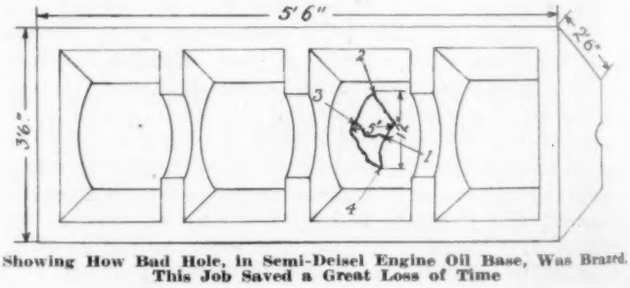
Nobody in the industry is more concerned with educational possibilities than our good friend Mr. Salesman who sallies forth every morning in search of the elusive order. He is given a certain amount of training himself and is supposed to add to that by study and practice and bear the burden of passing it all on to the user or prospective user. He has his own individual opinions on who needs to be taught and what we ought to teach them. He needs all the help we can give him individually in securing information about the stuff he sells, and he needs all the help we can give him indirectly by paving the way through educational work. Furthermore, he usually knows whether we are helping him or not and governs himself accordingly. This is largely a matter for individual manufacturers to handle in their own way but in general it is worth while to keep an eye on the sales force and see that they are not only provided with plenty of good ideas but are encouraged to assimilate them.

Without discounting any of the good work which has been done along the lines suggested throughout this discussion it is safe to say that anyone who is interested in the development of the welding industry can find more things to do which will count. A still further attempt at organized work along these lines is very desirable. In fact, it must be made if more progress is to be made.

BRAZING SAVES TIME

By F. W. Jessett, Man., Canada

A short time ago I was called to a rush job at our local power plant. When I arrived on the scene, I found that the job consisted of a semi Diesel Engine, the oil base of which had been broken. A piece of the piston broke off and dropped to the bottom of the oil base and as the connecting rod did not have sufficient clearance to pass the broken piece it punched a hole right through the



Showing How Bad Hole, in Semi-Deisel Engine Oil Base, Was Brazed. This Job Saved a Great Loss of Time

base. This hole was 12 inches by 5 inches and the piece was broken out in two pieces, as you will notice from the sketch.

I looked at the job on Friday morning when the engine was torn down, the base being turned up-side-down in order to get at the fracture. This engine was wanted for Saturday night to take care of the peak load. There was no time to be lost, for the engine must be in shape by that time. The only way I could see to repair the oil base was to braze the patch in. My reasons were that there was not enough time and no way to pre-heat the casting, and there was no electric welding outfit available. This casting weighed over 3,000 pounds.

First I bevelled the hole and as the patch metal was ¾ of an inch in thickness I fitted it into the hole and tacked it in place at the points indicated in the sketch, 1, 2, 3 and 4. Then I started to braze, beginning midway between points 1 and 2 and brazing about two inches at a time. After brazing two inches it was necessary to wait until the braze was cool enough to comfortably hold my hand on it. The next braze was midway between 3 and 4 for two inches. This alternate brazing and waiting for the piece to cool continued until the entire section was brazed in. Owing to the heavy metal it did not take long for the section to cool as the base was also covered with well packed, wet asbestos which was changed and resoaked between welds. It took about three hours to do the entire job and the engine was running on regular schedule that Saturday evening. This piece of work was done last July and has given perfect satisfaction ever since.

Torch Repairs Locomotive Lubricators

Neat Repair Work on Reducing and Rethreading Filling Plug Holes Is Done With Torch—Method Is Simple But Is Best Practice on This Kind of Job

By Frank Bentley

THE torch and welding rod have produced some very neat and practical methods of locomotive repair work. Loading and plugging in many instances are indeed the most convenient and economical short-cuts back to standards, the value of which are well known to anyone repairing machine parts of almost any nature.

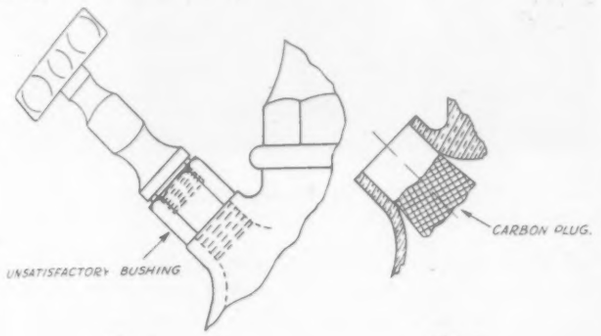


Fig. 1 Fig. 2

The sketches and photographs following are descriptive of a method of reducing and rethreading the filling plug holes of locomotive lubricators, particularly the older and smaller Bull's Eye type of which there are many still in use. This type have the filling plug holes a direct opening into the casting of the body, although in some of the newer makes, the seat is sometimes made with a removable (L. H.) threaded bushing.

Two practical, but not entirely successful methods of securing a new thread and seat often resorted to, were: to retap the hole to a larger size, making a special or over-size plug to fit; the other to retap and apply an extension bushing, the upper or female portion being threaded to take the standard filling plug. Fig. 1 shows this unsatisfactory way often resorted to. In the case of the enlarged plug, the standard was broken away from; stock plugs of standard size would not fit, and the loss of the plug (a frequent occurrence) many times caused delay until size could be taken and another part made. As for the extension bushing, it presented two joints to keep tight instead of one. The bushing could not, because of its location, be made large enough to stand much of a strain in tightening it into the body of the lubricator. Expansion and contraction of the body soon loosened it, and it generally came out instead of the filling plug when turned to remove it for filling.

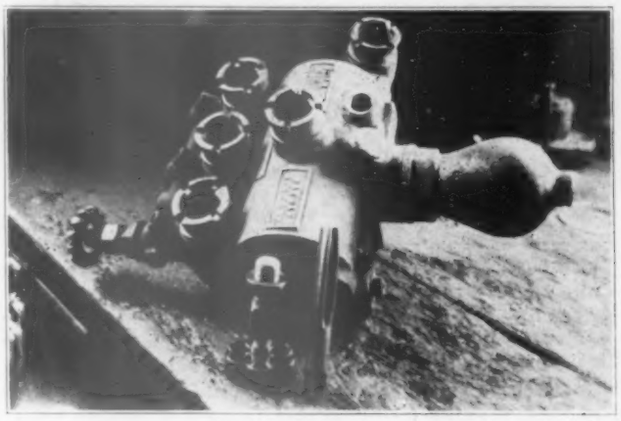


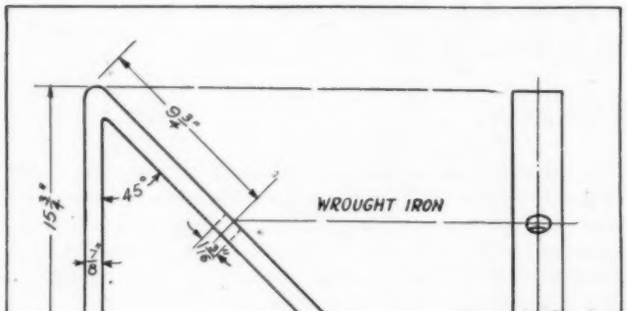
Fig. 3

The few operations to rethread a worn hole and get back to standard by plugging with bronze welding rod metal are as follows: The worn threads of the old hole are removed by reaming or chipped away with a round-point chisel to clean metal; a small stick of round carbon is stuck in the bottom of the hole to fill on, and the hole quickly run from a Tobin bronze welding rod. A certain amount of warming of the near metal is, of course, necessary. Fig. 2 shows hole ready for plugging over the carbon. Its insertion and tapping in place are easily done through removal of the end or glass T plug. Fig. 3 shows a filling plug hole neatly run or plugged with metal.

The filling plug hole is inclined 45 degrees from the vertical center line of the lubricator. Fig. 4 shows an angle iron to

Fig. 5 Fig. 7 Fig. 8

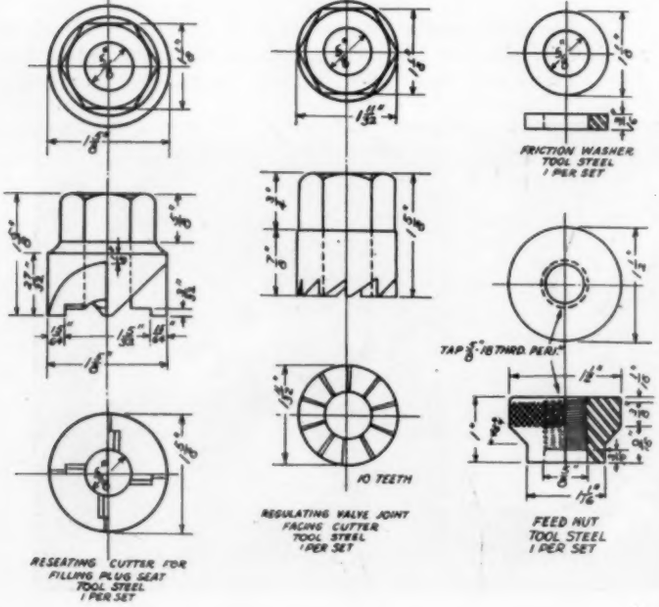
which the lubricator is secured by its holding nut at the back. The iron bolted or clamped to the face plate of the drill press, permits a quick centering and drilling of the standard filling plug tap hole. Fig. 5 shows the lubricator and iron on the press for this operation.



ANGLE IRON TO HOLD LUBRICATOR ON FACE PLATE OF DRILL PRESS AT ANGLE OF 45° WHEN DRILLING LOADED FILLING PLUG HOLE.

Fig. 4

Tapping and facing follow. Fig. 6 shows in dimension the details of the facing tool. Simple in design and easily constructed the part can be made locally in a very moderately equipped tool room. Fig. 7 shows the filling plug facing tool in place. Fig. 8


RESEATING CUTTER FOR FILLING PLUG SEAT TOOL STEEL 1 PER SET
10 TEETH
REGULATING VALVE JOINT FACING CUTTER TOOL STEEL 1 PER SET
FRICTION WASHER TOOL STEEL 1 PER SET
TAP ⅝"-18 THRD. PER I"
FEED NUT TOOL STEEL 1 PER SET

is of the filling plug hole at completion of the operations, with perfect thread, smooth seat face and ready for a standard plug.

The whole method is, of course, simple in the extreme. There is nothing exceptional about tools or steps taken in the work, but its application to this particular locomotive part might bring out a new twist to the work of repairing them. The writer has repaired quite a number of lubricators in this manner, and has not lost a one due to the metal opening up, cracking, or becoming porous in the process of plugging.

MECHANICAL BLACKSMITH HELPERS

The Blacker Engineering Company, Inc., Grand Central Terminal, New York City, are the manufacturers of the Blacker "B" Hammers, one of which is illustrated in the accompanying photograph. The manufacturers claim for this hammer a better directed and more human blow or strike, than is obtained with various forms of power hammers. The device operates on a pat-

Blacker Blacksmith's Hammer

ented lateral transverse motion, allowing the hammer to strike any desired spot on the anvil. It is geared direct, with a view to securing a positive blow, and control superior to that of belts and pulleys.

The hammer is specifically designed for the general maintenance, jobbing, tool and repair work, of necessity now handled by human strikers. It enables the smith to work alone with the ordinary hand tools, and to control with his foot a hammer which will strike a firm blow at any desired spot on the anvil.

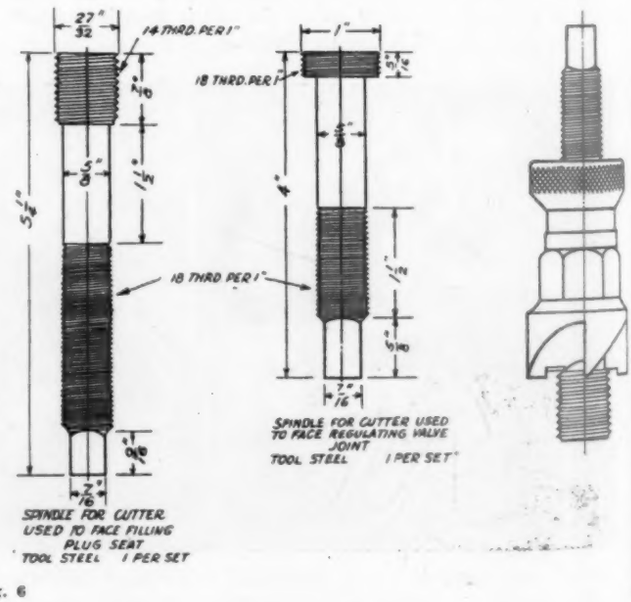

14 THRD. PER I"
18 THRD. PER I"
18 THRD. PER I"
SPINDLE FOR CUTTER USED TO FACE FILLING PLUG SEAT TOOL STEEL 1 PER SET
SPINDLE FOR CUTTER USED TO FACE REGULATING VALVE JOINT TOOL STEEL 1 PER SET

Fig. 6

CARBIDE RESIDUE, ITS VALUE AND USES

The Union Carbide Sales Company, of New York, has recently published in pamphlet form a paper prepared by Frank B. O'Connor on the subject of Carbide Residue, Its Value and Uses. This was read before the 1923 convention of the International Acetylene Association. It is well written, instructive and consists of 22 pages. All who are interested in this subject may secure additional copies from Union Carbide Company at no expense.

Fabricating Large Structures*

Structures Specially Adapted for Welding—Detailed Account of Successfully Welded Structures—Need for Further Research

By H. Goldmark†, W. Spraragen††, and W. L. Warner†††

Lockgates and Caissons

AMONG structures especially well adapted for the use of welding, lockgates, caissons and similar works employed by hydraulic engineers may be mentioned.

Structures of this kind are intermediate in character between ship construction and bridge work. A large part of the material used in them consists of steel plates of varying thicknesses, designed to support water pressure, but there are also heavy girders, vertical and horizontal bracing frames, and decks forming the skeleton of the structures.

In order to obtain water tightness, it has been necessary in the past to use a large number of rivets, quite closely spaced and to caulk the edges of all the other plates. In the case of most of these rivets, the direct stress is quite small, although in some parts of the gate frames there are a relatively small number of rivets under rather heavy stress.

It is believed that a careful analysis of structures of this kind would show that, by making some changes in the design, welding might with advantage be substituted for riveting and caulking in a large part of the work, although it might be best to use rivets for certain connections.

An example of structures of this kind may be found in the large lockgates used on modern canals.

On the Panama Canal, for instance, there are in all 94 mitering lockgate leaves, each weighing on the average about 300 tons. The length of the leaf is 65 ft., its thickness 7 ft., while the height varies from 45 to 82 ft. The framework consists of longitudinal horizontal girders, spaced 3 ft. 8 in. to 5 ft. apart with vertical frames 7 to 8 ft. between centers, built in between the horizontals and forming a complete vertical bracing for the gate frame. Both faces of the leaves are covered with steel plating.

The horizontal girders and the individual bracing frames were shop built, but over 6,500,000 rivets were driven in the field, for connecting the bracing and attaching the outer skin. It was also necessary to do a large amount of caulking.

The driving of this enormous number of rivets was a rather serious undertaking. In order to insure water tightness it was thought best to punch the rivet holes quite small in the shop ($\frac{11}{16}$ in. diameter for $\frac{7}{8}$ in. and 1 in. rivets) and then ream them in the field.

It proved difficult to do this without introducing chips into the space between the plates, which interfered with getting tight rivets.

It was also hard to get a sufficient number of experienced riveters, since as many as 165 gangs were required at one time. The number of rivets rejected on inspection was very great, which increased the cost to the contractors and led ultimately to a large claim against the Government, met in part by an additional Congressional appropriation.

It is believed that in the case of a large proportion of both the shop and field rivets, welded joints could have been substituted and the troublesome caulking of the plates could also have been eliminated. It would probably be necessary to modify the design in some respects, but there seems to be no reason for doubting that with due care a gate of equal strength could be built at decidedly lower cost.

Cost Data

No reliable figures are available as to the comparative costs of welded structures and ones fabricated by riveting. In the shipbuilding field, however, some such data has been compiled which are available. In a paper read before the Society of Engineers and Shipbuilders in Scotland Major James Caldwell brings out that in the construction of a cross channel barge the following savings were effected—245 man hours and 1000 lb. of metal.

The comparative costs of building this barge are $1,462.86 for the welded construction as against $1,892.48 for the riveted. It should be noted that the design was not particularly adapted for welding. In the report prepared by Mr. Ewertz (previously referred to) some comparative costs for riveting versus welding are worked out in a number of operations. A summary of these, including overhead costs, are as follows:

Name of Fitting	Number Pieces	Rivets Per Piece	In. of Welding Per Rivet	Total Riveting Cost	Total Welding Cost	Saving by Welding
Cargo batten clips	98	2	10	$ 97.32	$127.61	—31
Large awning pads	20	2	9	44.96	21.81	51.5
Small awning pads	24	2	4.75	44.13	20.61	53
Triangular hand rail stanchions	48	3	6	126.36	56.79	55
Vertical hand rail stanchions	115	2	9	142.93	137.72	4
Pipe hangers—F. W. line	57	2	4	118.26	70.66	40.4
Pipe hangers, drain and fuel	92	2	8	191.10	141.71	26
Clips—pump room, pipe hangers	6	4	9	14.70	13.24	9.8
Clips, pump room gratings	24	2	8.5	42.77	35.47	17
Bounding angle butts	50	....	....	329.05	71.68	78

Existing Welded Structures

In a paper printed in the Journal of the American Welding Society entitled "Arc Welding of Steel Structures," Prof. F. P. McKibben describes and illustrates a number of existing structures which are quite varied in nature. These include the following:

1. Stables for the Olympia Horse Show, England, 1920. The building covers an area of over 9000 sq. ft., the span of the roof trusses being 14 ft. All steel parts were cut to length and delivered to the site of the building ready for erection, where two welders and four laborers obtained an output of ten completed trusses per day.

2. Mill building at Brixton, England. Mill building has a saw-tooth roof covering 22,000 sq. ft.; having roof trusses of three spans each of 19 ft. and supported on "H" section columns. Truss members were cut to proper lengths and then placed in jigs where they were held in position and the joints welded. The truss was then removed and erected.

3. Cross Channel Barge for use between England and France. Length 125 ft. 9 in., breadth 16 ft. 4 in., molded depth 7 ft. 9 in., shell plating $\frac{1}{4}$ in. and $\frac{5}{16}$ in. lapped and joggled. The plates were assembled by means of a few service bolts, which after the welding of the joints were withdrawn and the holes closed by means of arc welding. Several barges of this type have been built in England.

4. The 500-ton coasting ship Fullager, launched Feb. 5, 1920, length 150 ft.

5. Transmission line towers have been constructed in Bel-

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*Presented at the Fall Meeting, A. W. S., Cleveland, Oct., 1924.

†Consulting Engineer.
††Secretary, American Bureau of Welding.
†††Industrial Engineering Department, General Electric Company.

gium having a height of 72 ft., carrying 7 wires on 525-ft. spans. All parts were electrically welded except for convenience in transportation the upper and lower sections were spliced together in the field.

6. At Fitzroy the Metropolitan Gas Company constructed a gas-holder of 2,000,000 cu. ft. capacity which, except for the assembly rivets,, is electrically welded. The diameter of the tank is 150 ft. and has four 35-ft. lifts. The latticed guide columns are 130 ft. high. Still another tank 200 ft. in diameter was constructed in Melbourne, Australia. (Fig. 13.)

Fig. 12—Launching of Welled Vessel Ac1320

7. Large boom for a derrick, approximately 90 ft. long. Except for a connection at the middle of the boom, all joints are made by arc welding.

8. Gondola freight car. The American Car and Foundry Company designed a Gondola freight car of 50 tons capacity in which electric spot welding was used in the superstructure.

9. Transformer tower, General Electric Company constructed at Schenectady plant a steel frame 40 ft. wide x 40 ft. long and 40 ft. high to serve as a transformer tower, all parts being arc welded. The structure contains 34,339 lb. of structural steel.

10. Steel bridge. A steel bridge connecting two buildings was constructed by the General Electric Co. by means of electric welding, only a few rivets being used at the connection of one of the buildings.

Other Examples of Welding Structures*

An All-Wheeled Steel Floor. An all-welded steel floor was constructed by the Hershey Chocolate Company, 64 ft. x 24 ft., for their milk receiving room. Heretofore cement and bituminous flooring were used with more or less leaking and a great tendency to crack. Three hundred thousand pounds of milk enter this room daily, mostly in 100-lb. cans. The plates were cut 4 ft. x 10 ft. x ⅜ in., planed to a 45 deg. bevel. The floor had to be 100 per cent waterproof and have as great a resistance to shock and abrasion as possible. With this type of struction it was possible to slide cans over a smooth surface, netting a saving on labor alone of about $1,200 annually.

One Hundred Foot Welded Tower. This tower was completed in a cave in California and is built up of spiral strips of steel inclosing a spiral stairway. Every joint of the 7200 in the structure was welded by the electric arc. The cost of the completed tower was $3,000 as against the lowest estimate on the riveted structural steel tower of $12,000. The steel used in the welded tower was slightly over 3 tons. Similar weight of a bolted and riveted structure is 13 tons.

Eighty Thousand Barrel Tank. The bottom of a tank 117 ft. in diameter was constructed in the oil fields of the Southwest. Plates were 18 ft. x 6 ft. x ⅜ in., each weighing about 900 lbs.

Welded Floating Roofs. A floating welded roof for a gasoline tank 30 ft. in diameter was constructed by the Chicago Bridge and Iron Works to protect gasoline tanks from evaporation and fire hazard.

Arc Welded Radio Towers. Two welded radio towers, 115 ft. high, largely made of steel pipe, were built two years ago at Peking, China. Requirements were to support a horizontal antenna pull of 3000 lb. at a height of 150 ft. and to use a limited ground space with a permanent support. Funds and time were limited. There are several distinct advantages to befound in the design and construction of this tower. First, all members of the tower are round and hence offer a relatively small resistance to the wind, which is important as a great part of the stresses produced on such a tower is caused by the wind acting on the tower itself. Second, pipe sections give nearly perfect columns, having the great strength with a given amount of metal. Third, the details are so arranged as to make use of nearly all scraps resulting from the cutting of the main members. Fourth, electric welding is much easier, quicker and cheaper than riveting on work of this nature, and if properly done it is just as reliable as riveted work. Fifth, the use of material of light weight permits the easy erection of long shop sections. Sixth, the finished tower has smooth, easy lines and offers a pleasing appearance.

Arc Welded Naval Structures

1. Tug boat having a length of 42 ft. beam of 11 ft. and a depth of 6 ft. 6 in. Boat constructed of steel with shell plating ⅜ in., frames 1½ in. by 1½ in. angles, and bar keel 1 in. by 5 in. Tug compelled in winter to break through ice 8 in. in thickness. Once it was caught between two large ships and her side crushed in 18 in., raising her deck 6 in. This damage was repaired by using hydraulic jack to press the sides out to proper places and neither these extraordinary stresses nor other service conditions have in any way started or cracked the welding.

2. Welded Caisson. An all-welded steel self-floating caisson was constructed in Japan for the 460-ft. dry dock at Hikoshuma drydock.

3. Welding pontoon for crane at Kobe plant 65 ft. long 35 ft. folded breadth and 8 ft. molded depth, having a rectangular form in cross sections.

4. Battle Towing Target. A 172-ft. battle towing target was constructed at the Norfolk Navy Yard by arc welding.

Inspection: One of the greatest handicaps to welding is the contention that welds are lacking in uniformity and that it is not yet possible to tell when a welded joint is good or bad. It is a well-known fact that in a riveted structure not all the rivets have the theoretical strength that they are supposed to have. If the rivet is too cold or the thickness of steel to be riveted too great or the pressure of the riveting machine not sufficient, the rivet is not upset enough to fill the hole and the proper bearing of the rivet upon the plate is not secured.

In his paper on "Applications of Arc Welding to Ship Construction," Mr. Ewertz states:

Riveting, also, has its hazards, for heavy locked up stresses are produced in the driving of a rivet and stresses are set up in the plating nearby due to hammering. It is often impossible with the best workmen to obtain fair rivet holes and therefore rivets are frequently driven into odd shaped holes, adding uncertainty to the results obtained. While the testing of rivets is readily performed, it is frequently found in tests of compartments that the water produces an excessive strain on the rivets. Again, rivets having passed all the tests during the ship's construction are sometimes found incapable of standing stresses produced by the ship working in a heavy sea.

**These examples of welded construction have been described and illustrated in The Welding Engineer. Further details may be had upon application to the Editor.*

the various members of a ship's structure, to make and punch rivet holes, to bolt together and fair up the various parts, is labor that is little understood by the average engineer. The hazards, however, due to human incapability to produce perfect work are offset by the liberal margin for safety allowed for in the classification rules; therefore, we seldom hear of disaster to a ship due to faulty construction.

However, structural engineers will argue that there are enough rivets so that even if 15 per cent of them are bad the factor of safety is such that the riveted joint will withstand the stresses which it meets in service. Moreover, a loose rivet does not necessarily mean that it has no strength. As previously indicated in the report wherever possible, the welded structures should be designed such that there will be a great many welds instead of all the strength concentrated in one place.

The real solution, however, is inspection, proper materials, apparatus and skilled workmen.

It is perfectly possible to have inspectors so trained that during the welding processes they can see whether proper welding is being done. As a matter of fact a good operator knows whether he is doing a good job. Conscientious workmen are quite necessary if the use of welding is to be extended. On a number of occasions prominent welding engineers have expressed an opinion that the skill of welders should be tested before they are put on the important work. This is very readily done but it does not alter the fact that conscientiousness on the part of the workmen is absolutely necessary for under test he may do a 100 per cent job while in service he may be careless.

Corrosion

The following excerpt on the above subject is taken from Mr. Ewertz's paper:

Corrosion of Arc Weld Metal in Sea Water

A. G. Bissell, of the general engineering department of the Westinghouse Electric and Manufacturing Company, while at the Puget Sound Navy Yard, had an opportunity to examine many arc welds that had been in sea water for various lengths of time. In no instance was the arc weld metal corroded any more than the surrounding plate material except where it had been used to build up rivet heads on ships' rudders. Unwelded rivet heads in this same vicinity were also badly corroded. From a careful examination of the rudder of the U. S. S. Arkansas is was found that both welded and unwelded rivets on the forward end were corroded while a few feet along the side of the rudder were several welded rivets, none of which showed any signs of corrosion. It was concluded at the time that the corrosion was due to the electrolytic action between the steel of the rudder and the bronze propellers, the action being concentrated at the rivet heads.

The only information which the General Electric Company has on the ability of a weld to stand corrosion is that in connection with the 12 ft. cubical tank which was made for the Emergency Fleet Corporation. This tank when completed was exposed to the weather for 5 years and a piece recently cut out on the side which included a welded joint, showed that the depth of oxidation in the weld was just the same as on the plate, giving evidence that the welded portion is not any more susceptible to corrosion from ordinary conditions than the plate itself. The plate was ½ in. ship plate.

Needed Data

There is no question that structural engineers who read this report may be favorably impressed with the possibilities of welding. It is also certain that were they inclined to specify the use the welding they would at once be confronted with the need of certan tests and data that are now lacking. This information would come under the following heads.

1. *Accurate Cost Data.* Making it possible to readily compute the cost of any particular welded structure. The basis for this information is already available. Figures for specific jobs would have to be compiled from experience.

2. *Tensile Strength.* Much information on this subject is already available. It may be necessary to make a few tests on specific types of joints, materials and methods.

3. *Stearing Strength.* A little information is available. Much more is needed.

4. *Resistance to Shock.* In certain instances completed welded structures will have to be tested. In most instances, howver, there is enough information already available.

5. *Bending.* Here again tests for bending would have to be made in certain completed structures; the bending qualities of small specimens are well known.

6. *Welding Wire.* Specifications for welding wire found satisfactory in service are already available, having been compiled by an appropriate research committee of the American Welding Society. However, certain tests will have to be made for specific materials to check their merits.

7. *Tests for Operators.* Specifications for making and testing welded test specimens are already available.

8. *Inspection.* Careful instruction will have to be worked out for inspectors. In fact, a short training course might be necessary.

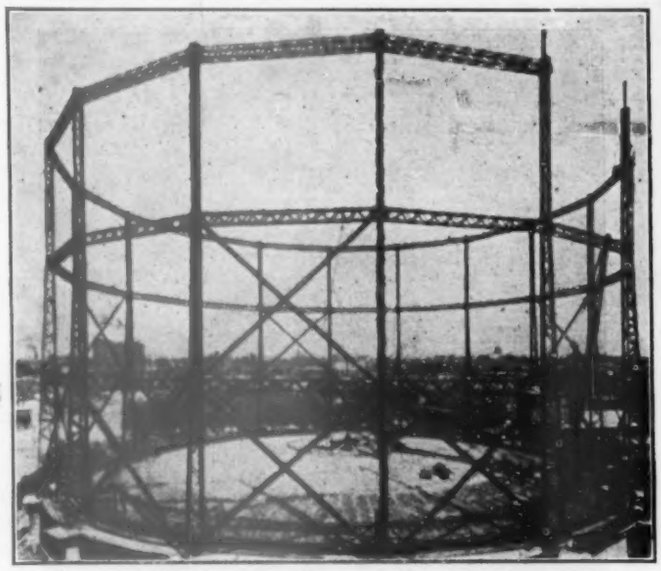


Fig. 13—Completing the Third Bay of a 2,000,000 Ft. Gas Holder at Melbourne, Australia. Note the Welded Guide Carriage

9. *Materials.* It is quite likely that the present quality of steel will be entirely suitable for welding. Closer attention will have to be given to the physical and chemical properties. In all probability closer tolerances and additional chemical and physical requirements will be found necessary.

10. *Design.* This is by far the most important subject that will have to be considered by structural engineers. Designs will have to be developed for specific structures that are suitable only for welding. As previously pointed out in the report, it will be possible with the design of structures, including shapes, methods and materials prepared with only welding in mind, to effect considerable economies and obtain structures that are better than similar riveted ones or ones where both welding and riveting could be used.

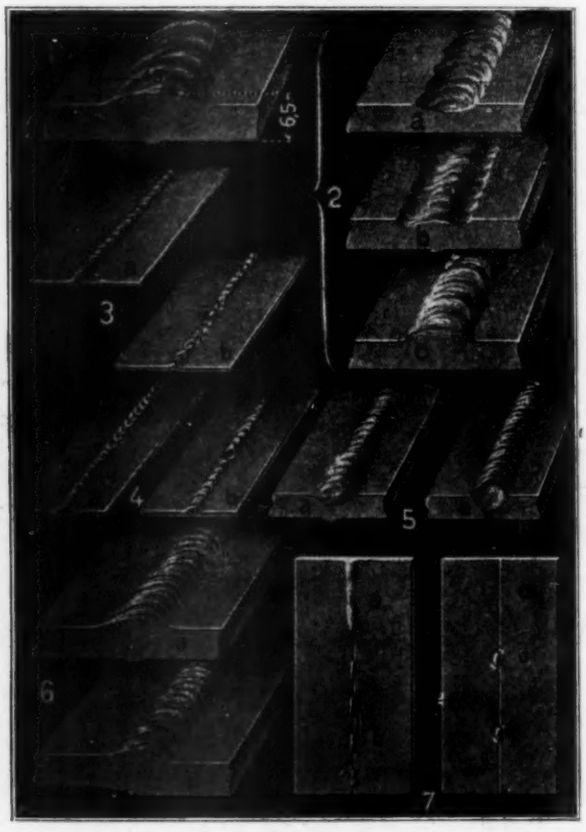
11. *Methods of Assembly.* This is a very important feature. Standardization based upon experience will undoubtedly be brought about in time and will be necessitated if lower costs are to result.

The Buckeye Oxygen Company has broken ground for an extension to its plant at Canton, Ohio, the equipment for which will be in operation about May 1st. A. W. Bullard has been appointed sales manager.

Visual Examination of Welds

Some Surface Indications of the Quality of the Welders' Work and Danger Signs Which Predict Failures

GOOD supervision of oxy-acetylene welds constitutes a very difficult problem, according to a Mr. P. Hollard, who contributed an excellent article on the visual examination of welds to a recent issue of the *Revue de la Soudure Autogene*. He adds that a definite solution of the problem would be joyfully welcomed by all industrial plants who use the welding process in their production or who use welded articles. A unique comparison was made between welds and the human body. He points out that the testing of welds by destruction is, in some cases, about as useful as an autopsy, in that the patient is not benefited no matter how much information is secured by the diagnosis of the operator. Bending or breaking welded samples constitutes the best means



Welded Test Pieces

of judging the workmanship of an operator or the quality of a metal which has been fused. Such tests are indispensable when instructing welders, as it provides an adequate method of supervision and a fairly definite control over the labor. But, to control the mechanical value of a piece constructed by welding, which often depends upon the value of the welds themselves, destructive tests are not possible except in certain cases for certain test pieces. And, this sort of work is somewhat slighted because it is rather uncertain in its results and in large plants it is a rather burdensome process. It is pointed out that we can judge the tightness of a weld by using kerosene or pressure tests, but in the present state of our knowledge it is almost impossible to form a definite judgment on the resistance which a welded joint will offer in service if we do not wish to destroy or damage it.

As far as visual control of welding is concerned, it is, of course, impossible to tell with a naked eye or even with a magnifying glass the exact character of a welded joint. But, the author of the article mentioned above points out that there are a great many signs easily visible which give the supervisor some basis for judging the probable quality of the joint, according to the appearance of the operator's work. We will make two classifications of method of visual control, says Mr. Hollard; that exercised in the course of the work, and that to which one proceeds with leisure by examination of the finished piece. For any one who is well acquainted with the practice of oxy-acetylene welding it is easy to see whether an operator is working well or poorly, whether the movements which he gives to his torch are systematic or not, whether he fuses the edges well or pushes the adding material ahead onto the cold surface of the bevel. Of course, the welder himself ought to know these things but there has not always been an opportunity to teach them to him and a competent foreman renders a valuable service, both to the operators and to his superiors, when he watches these details carefully.

Turning now to the matter of visual control by the inspection of finished welds, we are dealing with something which can be applied to all welded pieces, whereas it is impossible to watch all the welders constantly throughout the duration of their work. We have the problem of studying the appearance of the welds and judging their qualities and defects from its appearance. There is no question but that this task would be much easier if we could always examine these welds on both sides. In some cases the back of a weld is even more instructive than the face of it and whenever it is possible the back of the weld should certainly be inspected. In order to do this it is sometimes necessary to exercise quite a bit of ingenuity by using flashlights, mirrors, etc., but the time spent in this way will certainly not be lost. If we cannot always examine more than the exterior or face of the weld, we must then give all possible attention to the visible parts and try to guess at the appearance at the bottom from what we learn by the inspection of the top. For example, if we are concerned with a weld that is too narrow and, in addition, we notice the sheets do not seem to be in the same plane but slightly out of level we are justified in thinking that our puddle has not thoroughly penetrated the whole thickness of the metal and that by reason of the lack of alignment one of the lower edges of the sheet probably forms a projection which has not been melted and this little projection would lead us to expect that a narrow crevice would be present. A weld of this sort would offer little resistance to bending stresses for it is incomplete and contains an incipient crack which will easily spread to the center of the piece.

It is true that all welds can present to the eye a multitude of different characteristics but these characteristics can be classed in groups giving valuable indications both as to the mechanical value of the joint and the economy of the method of execution. But, it is above all the quality, the probable strength of the welds, which interest us, because the economical factors can be determined in other ways. The speed of an operator's production is easily judged. It is more difficult to judge the quality of the production.

To show how it is possible to proceed to a critical visual examination of welds with a view to determining their qualities and defects several examples of welds on steel sheets have been grouped in the accompanying illustration. Consideration will be given first to the top or face of the weld, supposing that the back or bottom is invisible. The line of the weld presents a certain width which should be considered with respect to the thickness of the sheet. The very narrow weld inspires us with a certain dis-

trust for there is a good chance that the fusion which has been spread so little has not reached through the entire thickness of the metal and we have a lack of penetration. The width of the first weld is about three or four times the thickness (Fig. 1). The conditions are normal from this point of view, and we will have to look for other indications of defects. If, on the other hand, we notice extreme width of the line of weld with respect to the thickness of the metal we will conclude that the welder has used up a great deal of gas and lost time in fusing such a large mass and consequently his work is not economical.

Another question is that of reenforcement. We can consider as normal a reenforcement amounting to about one-third the thickness of the sheet which offers a good factor of safety. Then, we must examine the form of the hump. The weld shown in Fig. 1, whose reenforcement is 1.5 mm to 5 mm thickness presents a regular bulge sloping off well to plane surface on each side and looks like a well executed job. Turning now to Fig. 2 we see at A a trough in place of a hump, at B a gutter on each side of the weld. These welds are sure to be weak. At C, on the other hand, the reenforcement is too heavy and the added metal does not make a good union with the sheet because it leaves the surface too abruptly. The joint does not look like a good one and the welder has wasted time piling up metal.

If we now compare welds A and B in Fig. 3, we will immediately judge the first to be better than the second. The waves of solidified metal are regularly serrated, forming curved chevrons, all of which are good indications for a weld on thin sheet. The second one, however, is made up of a series of little patches of metal separated by holes and irregular. If we were dealing with thicker sheets these differences would be still more noticeable and we would be able to see that the surface of a good weld is smooth and that of the other rough, a result which may be due to either the quality of the sheet or the manipulation of the torch. Although the beauty of a weld is not a certain indication of its quality, nevertheless, we can see whether the man who made it is clever or not, especially if he lowers the strength of the joint by leaving the holes imperfectly filled, etc.

A long weld is not generally made without stopping. Sometimes it is necessary to stop the work and take it up again, often in the opposite direction. It is well to examine carefully the points where a weld has been resumed for frequently defects are found there. Let us consider the welds A and F in Fig. 4. We can see, toward the middle of the first piece a change in direction of the ripples. If we do not notice any holes or even a pin hole at the point of this change of direction as seems to be indicated here in spite of the small dimensions of the picture, we can conclude that the welder has been very careful when resuming his work. But, in the middle of weld B, although the work has all been done in the same direction, we notice a small crater which is very significant. The welder having stopped for some reason has not resumed welding at a point back of where he stopped. If this weld had been made on a vessel for containing liquid under pressure we would see a stream of water squirt out of this little crater at the first test. It is important, then, to pay careful attention to the points where welding has been stopped and resumed.

In Fig. 5, we find two methods of finishing a weld at the end of a sheet. The first (A) which is a good one shows that the welder has done a little extra work for a short distance from the end and has left an excess of metal at the edge of the sheet. On the other hand, the second (B), without considering the crack left through failure to penetrate which is clearly visible, has stopped just as soon as he reached the end of the line, leaving a little bowl which does not look well and considerably weakens the end of the joint.

In addition to the line of the weld itself it is equally worth while to observe whether the sheets are held in the same plane. If we are able to examine the plane in cross section as in Fig. 6, it is easier to see whether they are in the same plane, as at A, or out of alignment, as at B, leaving at the bottom a break in the continuity and consequently an incipient crack. In the case of a closed vessel, however, where we can only see the outside, it is more difficult to determine whether the sheets have been forced out of level, which is an almost certain indication of an incipient crack.

These defects, visible in the exterior, which we have just discussed separately and the others in addition to them can always be present in combination. We can have an irregular weld insufficiently built up, with low spots, misaligned, etc. The more of these little indications we find the more inclined we should be to pass unfavorable judgment on the work. Let us examine the backs of the two welds in Fig. 7. At the left we see at A a continuous strip of metal well poined to the sheets with perfect penetration. At B there are drops, regularly spaced, and a line showing the slight lack of penetration which may exist between them. The weld at the left would certainly stand up under the normal stress to which it would be submitted in practice but we cannot say as much for the weld at the right. The line of separation of the edges appears almost for the entire length to be ready to open under any bending stress. However, we perceive from place to place some drops that have penetrated but if we examine them carefully we will see that they are not well joined to the edges of the sheets but are encircled by grooves. These little drops are held to the adjacent metal only by a thin bond of oxide and their presence does not constitute any guarantee at all against certain rupture of this weld under stress.

These few examples have directed attention to certain important characteristics, which are particularly important, to show the spirit in which the examination must be conducted in order to draw the best conclusion from a few indications. This discussion will not be particularly valuable unless those who wish to acquire a good knowledge of welding and the qualities of a good weld are willing to give some time to study the bending and breaking of test pieces, and then exercising their faculties of observation and reason.

THE WELDING INDUSTRY IN FRANCE

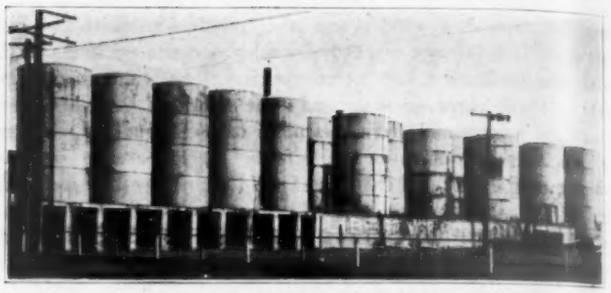
In a recent issue of the Revue de la Soudure Autogene are some interesting figures which indicate the importance of the welding industry in France. The consumption of calcium carbide in 1924 is given in excess of 65,000 metric tons, of which 45,000 metric tons is said to be used for welding. Oxygen production ought to reach six million cubic meters and dissolved acetylene two million cubic meters. It is estimated that there are 25,000 oxy-acetylene welding installations in France, employing a total of about 40,000 welders. In and about Paris it is estimated that there are about 3,000 installations employing about 5,000 welders, although the most of these are employed on production work and are not considered as professional all around welders. The article states that the number of qualified welders who know their work well and to whom any kind of work could be trusted is very limited, certainly not in excess of 20 per cent of the total of 40,000 operators. More than one hundred thousand torches have been put in service during the last ten years, of which it is estimated that eighty thousand are still in use, and the sale of new equipment either for replacement or for new installations should reach 15,000 torches per year. These are supplied by about a dozen manufacturers, two of whom produce about 75 per cent of the total volume. It is estimated that 75,000 metric tons of calcium will be used in 1925; more than 50,000 for welding, and that the oxygen production will be about eighteen million cubic meters.

WELDING MANUAL REVISED

The Manual of Instruction for Oxy-acetylene and Electric Arc Welding Operators published by *The Welding Engineer* has been completely revised by substituting the instruction courses given in *The Welding Encyclopedia*, Fourth Edition, for those which appeared in the Third Edition. This results in a considerable improvement in the usefulness of the manual, which is not a text book, but simply an outline of instruction courses. It is furnished without charge to welding instructors, supervisors and others who have student or apprentice welders to instruct in either process.

Seamless Tanks Are Leakless Tanks*

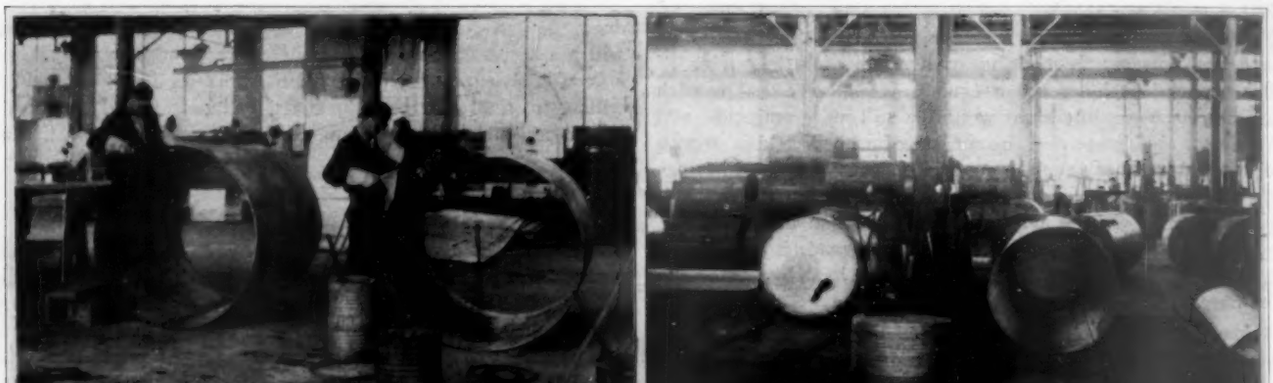
Evaporation and Leaking Checked by Welding —There Is no Upkeep or Maintenance on Welded Tanks



Five Tanks at Left Are Welded—Leakproof. Others Are Riveted and Show Leaks

ONE of the things that greets the traveler's eye on approaching a town is the battery of streaked and grimy storage tanks. Even near the larger cities the same picture is sometimes seen.

There is no excuse for leaky, discolored storage tanks. Gradually but surely these eyesores are beginning to give way to more practical and sightly equipment for storing supplies of gasolene, kerosene, and lubricating oils for the local trade. The wise and particular oil man is discarding riveted tanks, with their loose rivet heads and leaking joints and replacing them with welded tanks. Welded joints are stronger and are permanently leakproof. Their clean, symmetrical appearance is a source of pride to the owner.



With Proper Organization Gas Welded Tanks Are Economical and Easy to Produce

If there is any type of tank in which the tightness and permanence of the joint is of prime importance, it is the station storage tank. Yet it was quite impossible, until the advent of welding, to build such a tank. Sooner or later the rivets work loose. The seams then open up, this resulting in important leakage and evaporation losses. In an effort to overcome this condition some manufacturers have resorted to expensive types of double riveted construction and to much heavier materials than are otherwise required. But even these expedients have not proved entirely successful. Only the application of modern welding methods can solve the problem.

In forming the joints of a welded tank, plate edges are fused together into one homogeneous whole. The character of the metal at the union thus produced is practically the same as that of the tank material itself. In effect the tank is truly jointless, as though it had been "drawn" from one piece of metal.

Punching holes in metal plates and then filling them with rivets seems altogether illogical on its face, and it is doubtful if it would ever have found favor but for the tardy discovery of modern welding. Recently an enterprising tank builder expressed himself pointedly.

"Is it reasonable," said he, "that you should punch holes in two sheets of steel, and by simply buttoning them together with little shanks of iron, expect to make a permanent, gastight joint? You can draw the sheets together and with a little calking close up the seams. But calking is only temporary at best. When I sell a riveted tank it is often necessary to send along a mechanic to recalk the seams after the tank has arrived at its destination. If a tank has been badly jostled about in transit or handled roughly in unloading and erecting, something is bound to happen to the seams. No matter how well the recalking is done, after the tank has been in use for some time, it must be gone over in the same way. This must be repeated, year after year, as long as the tank lasts.

"Of course it's being done, and has been done for a long time—too long. But that doesn't justify keeping it up," he concluded.

There was a time when people rode in stage coaches or sailed the sea in tiny vessels that would fit comfortably in the holds of modern ships. But with the advent of the railroad and the steamship we are no longer satisfied with those antiquated modes of travel. They were good enough until we discovered better things. As it was with the use of steam power so it is now with the lately developed art of joining metals.

When the heavy losses from leakage and evaporation of gasoline in a riveted station storage tank are considered, one cannot fail to be impressed with the potential savings, made possible by welded construction. Evaporation begins the instant a liquid comes in contact with the air. The exact amount lost through evaporation of any liquid in storage is difficult to determine; but as long as a tank remains in a leaking condition, that loss mounts up day after day. Often this will equal the total cost of a welded tank in a very few months.

There is no upkeep or maintenance expense in connection with a welded tank. It has no seams to open up or rivet heads to work loose. Initially tight it is always tight.

Experience has shown that a good welded joint is as strong as the parent metal, and it is no trick to make it stronger

Courtesy Linde Air Products Co.

when desired. This has been clearly proven by recent destruction tests on welded tanks conducted by the United States Bureau of Standards, the results of which are available to everyone.

Further economies are possible in welded construction through the use of lighter materials. In a riveted tank the plate is never working up to full duty—it is the joint which is the weakest point. Since welded joints are so much nearer the strength of the metal they join, reductions of as much as 25 per cent in weight of the material can be made.

Two Tanks on Left Are Riveted, Leaks Can Be Seen—Four Tanks on Righ. Are Welded, Leak Proof.

In the successful application of welding, just as in riveting, much depends upon the ability of workmen and the standards of workmanship observed by the manufacturer or contractor. No one would pick up an unskilled workman and set him to the tasks of a master boiler maker. It would be just as unreasonable to expect an ignorant laborer to do the work of an experienced welder. And yet the error is often committed.

With the elements of good practice thoroughly understood and conscientiously observed it will be found that it is also more economical to weld than to rivet. The cost of laying out, punching, drilling, reaming and other minor operations incident to riveting are eliminated. In preparing materials for welded construction, it is only necessary to shear the plates to accurate dimensions, and bevel them according to accepted practices. This can often be accomplished in one operation with the oxy-acetylene cutting torch.

Indeed, it is perhaps not too early to predict that with the continued and inevitable growth of the gas welding process the entire practice of punching holes in steel members, simply to fill them up again, will some day be relegated to the museum where the stage coach and the brig repose contentedly.

MOUNTAINS OF WELDING FLUX

Prospector Discovered Shale in Utah which Turned Out to Be a Welding Flux—Shale is Crushed and Melted with Iron or Copper and Poured into Rods—When Welding No Other Flux is Used

By Leo D. Roueche

THERE is a saying out here in the west that when the Creator finished making the world He dumped the "left-overs" down in a heap, and the center of this heap is now Utah. If such was the case He must have had quite an assortment of odds and ends, for in Utah almost every mineral known under the sun is found with the exception of diamonds. And now comes a new metal, which, so far as is known, is not found anywhere else in the world. It is a light grey, carbonaceous shale and what it was intended for has at last been discovered—it is a natural flux. There is a mountain of it, estimated at millions of tons—enough to weld the world together should it ever collide with a comet and get a fracture.

A Prospector's "Hunch"

A few years ago a prospector named Wm. B. Folsom picked up a piece of grey shale while prospecting down in Emery county in the central part of the state of Utah. It was different from any shale he had ever seen before, so he picked it up and examined it and put it in his sample pack: "It must be good for something," he said, "maybe it's oil shale." It was at the time when shale was just beginning to be talked of as a source of oil and Folsom thought perhaps he had been lucky enough to discover a whole mountain of oil bearing shale, for there was a mountain of it there.

But the oil possibilities of the shale did not turn out. He tried to burn it without succeeding and then with a hotter flame he tried to melt it and again he failed.

He had a "hunch" as prospectors often do, that the stuff was good for something, and what that something was he determined to find out. Being somewhat of a chemist, he set to work to analyze it but the task was too complicated and he had to give up. After trying the shale for every purpose he could think of, he sent a sample to the Kewin Company of San Francisco and asked them to examine it and see what it was good for. In the meantime he staked out some claims in the barren tract where the shale was found and worked occasionally at digging it out.

The company in San Francisco reported that while they were not able to determine all the elements contained in the samples sent, an assay showed that it contained vanadium. As there was no great demand for vanadium at that time and as no cheap means of extracting it from the ore was at hand, nothing more was done with the shale until the claims came into the possession of Ernest Fisher of Salt Lake City on an option. Mr. Fisher soon ventured on some experiments designed to extract vanadium from the shale. Samples were sent to competent chemists for an exact analysis. Some reported only traces of vanadium and all reported that there was some unknown element or elements which they were unable to isolate. It was believed by some to be a radio-active element. Mr. Fisher shared the hunch of his predecessor and still believed that the deposits of this shale would turn out to have some value, and he continued to experiment.

A Lead Copper Alloy

Then Mr. Robert S. Lewis became interested in the shale and together he and Mr. Fisher began to experiment more or less haphazardly. One day Mr. Lewis tried cooking it with iron. To the surprise of the experimenters it had the effect of making the iron much tougher.

The blow holes of ordinary cast iron were absent and a much better quality of machine iron than ordinary cast resulted. This encouraged further experimenting in mixing the shale with other metals. It was found that it would pour straight with copper with no other alloy and that the result was a good machine metal with a tensile strength of 24,000 pounds to the square inch. There was not just one experiment, there were many carried on over a long period and hundreds of tests were made in each case to determine the effects of mixing the powdered shale with metals in different proportions.

Encouraged by what seemed to be a series of successes, the experimenters next decided to try to mix copper and lead. An alloy of these two metals is said to be impossible, but with the aid of their magic shale, these men made it successfully. It is believed that this accomplishment constitutes their greatest triumph. They found that a mixture of as high as 75 per cent lead and 25 per cent copper with the addition of a small amount of the shale, remelted at a temperature of 1670 degrees F. A mixture of 50 per cent lead and 50 per cent copper remelted at 1750 degrees Fahrenheit. These high melting points go to show that they were true alloys.

(*Continued on page* 36)

Let The REGO Automatic Cut Your Wel

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Does it save Gas? Look here!

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February 14, 192[illegible]

The Shaffan-Blessing Company,
240-258 East Ontario Street,
Chicago, Illinois.

Gentlemen:

During the last two months I have been looking for a welding torch that was equipped with a fuel saving device. Upon interviewing you people, I found that your Rego G&A torch was just the kind of torch I wanted.

After putting the torch in service for ten weeks, I find that it saves us approximately 75% on our gas, because our operator does his own loading and unloading, and is only using the torch a small part of the time. For any kind of production work it ought to save at least 30 to 40% on the gas because of the fact that this torch can be extinguished when notin use and can be relit, without further adjustment, and will produce the same size flame as before extinguishing.

Another point in favor of this device, for extinguishing the flame, is that it is safer. With other torches, there was always the danger of someone getting burnt when the torch was idle.

This torch pays for itself, on its fuel saving, in a short time. Therefore, I intend to replace all the old torches with Rego.

Yours very truly,
Henry H. Schuman
HENRY H. SCHUMAN,
FACTORY SUP'T.,
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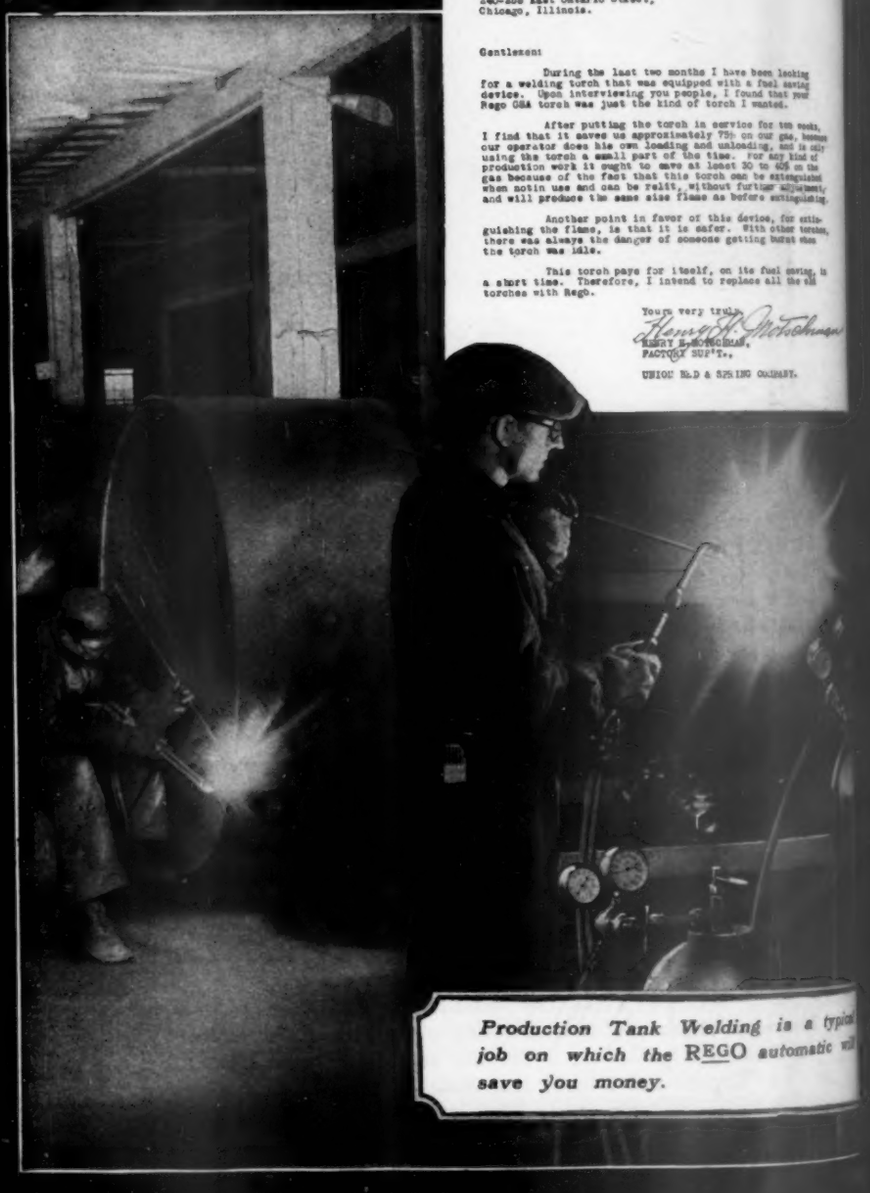

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SAFETY TOO! THE GASES DON'T MIX IN THE HANDLE
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A TIME SAVER VALVE PACKING NUT — I CAN GET AT IT.
THE SEATS CAN BE RENEWED IN A JIFFY
WHAT A CINCH! A REAL GRIP ON THIS VALVE HANDLE
AC

STOP WASTING GAS

When your torch is not welding

STOP WASTING TIME

In adjusting valves between operations

Use a

REGO AUTOMATIC SHUTOFF TORCH

a touch of the thumb and zipp! —Out goes the flame

When ready to weld, press the button, snap a lighter and zipp!—a perfect neutral flame once more.

One adjustment in the morning and your flame is good for all day.

Special Prices Until April 1, 1925

REGO GMA automatic — with 6″ extension and 6 tips —for medium welding up to 1″, each.....$37.50

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250 Jobbers and Service Organizations throughout the U. S. Any Sales Representative will give you the name of the jobber nearest you.

VISITORS to steel foundries are invariably much interested in the cutting of heavy risers. The whole procedure, from the time the casting is shaken out until the riser rolls off into the sand, will impress anyone who is a stranger to the busi-

Cutting Riser from Turbine Cylinder Casting

ness. The ease with which the average foundry equipment handles material is surprising, but the cutting of risers by the oxy-acetylene torch is by far the most spectacular.

It is a common occurrence for the outsider to put the question, "How did you do that before you had cutting torches?" This is a natural question. Not many years ago there were no cutting torches. Frequently, the reply to the question dwells on the difficulties of the old methods; the hours taken to do what now requires minutes, the risk of spoiling expensive castings, and the much greater amount of grinding and other machine work required to finish the job.

As a matter of fact, the advantage of oxy-acetylene cutting does not rest entirely with the ease and economy with which gates and risers can be removed. It has enabled the progressive foundrymen to be entirely independent of former limitations as to size and location of these risers.

It is generally well known that certain places on each particular casting or design should be fed by a generous pool of molten metal. This ideal was all too often compromised, simply because it was next to impossible to remove the risers from the inaccessible places where they were needed most. This is now all changed. The cutting torch reaches any portion of the casting with equal facility. Knowing this, it has been possible to redesign entirely the gating of troublesome castings, along logical lines, with the result that defectives are now few and far between. Thus many plants in this country are today making castings of sizes and types which it would have been impossible to produce before the advent of the oxy-acetylene cutting torch.

They have not only enlarged their range of production, but have increased efficiency and reduced production cost of even their former run of work. A case in point is furnished by the plant which produced the work illustrated in this article.

Most of the heavy cutting done at this foundry consists in removing risers ranging in size from 8 or 10 inches up to 20 inches. The steam turbine cylinder casting illustrated, is an example. In this work the risers vary in thickness from 12 to 20 inches. One man with a torch working alone on such a casting could probably have cut these risers within a reasonable time; but the management realized that such work was not a one-man job. They had studied the problem and concluded that additional money spent on labor and equipment would be returned in the final finishing. A machine cutting torch with a straight line machine as accessory is now employed, operated by three men; a cutter and two helpers. One helper maintains proper gas supplies and pressures and the other assists in holding the cut to the proper line. Cuts made in this way are very smooth, close to the line, and require a minimum of time for final finishing.

A more fundamental development at this plant is in the design of their larger molds. The huge marine gear shown, which weighed forty thousand pounds rough cast, is an excellent example.

The risers do not take the customary shape, of stems with projecting heads, but form an almost continuous ring about the

Note the Shape of the Risers Which Were Cut Off with the Torch

top of the casting. The six segments are separated only by a narrow space. Good quality steel for the face of the gear, where clear, clean steel is most needed, is supplied at every point by a generous pool of hot metal just above. The improvement in the quality of the work is natural. But this method of pouring could be adopted only because of full confidence in the ability of the oxy-acetylene process to cut the risers smoothly and economically.

Such results clearly illustrate that foundries can increase the scope of their production by thorough study of the possibilities of the oxy-acetylene process and at the same time better the quality of their steel castings while operating at a lower net cost.

CHEMICAL EQUIPMENT SHOW IN JUNE

The Chemical Equipment Exposition will be held at the State Armory, Providence, Rhode Island, June 22nd to 27th inclusive. Every American industrial executive is included in the general invitation to the Exposition. An advance list of exhibitors indicates that welding apparatus and supplies will be shown and demonstrated by the Linde Air Products Company, the Oxweld Acetylene Company, the Union Carbide Company and the Prest-O-Lite Company. In conjunction with the Exposition the American Institute of Chemical Engineers will hold four day sessions and there will also be special meetings of sections of the American Association of Textile Chemists and Colorists.

NEW A. S. M. E. CODE NOW READY

Announcement has been received that the new A. S. M. E. code for the construction of infired pressure vessels has been completed and is now ready for distribution. Copies may be obtained upon request to the Secretary of the A. S. M. E., 29 West 39th St., New York, for $1.00 each. The development of this code has been watched with great interest by members of the welding industry because considerable attention is given to the rules for the application of autogenous welding in the construction mentioned. A copy of the code as now printed will prove a useful bit of reference material because the A. S. M. E. regulations are accepted as standard in so many places.

Welding in the Ornamental Iron Works

How One Shop Adopted the Metallic Arc Method and Turned What Seemed to be an Absolute Failure Into a Real Profit

By Charles M. Rusk*

RECENTLY I was called into an ornamental iron shop and told that they had quite a problem on their hands. They then showed me a railing similar to Sketch No. 1 and told me that they had bid on this job with the intention of using cast iron castings for the squares at the top of the railing, but after receiving the contract were told that the squares must be made out of wrought iron the same as the pickets and flat bars. This would mean an additional cost of seven hundred dollars. They could not get these squares punched from wrought iron stock as the metal would tear and bend in the punching process.

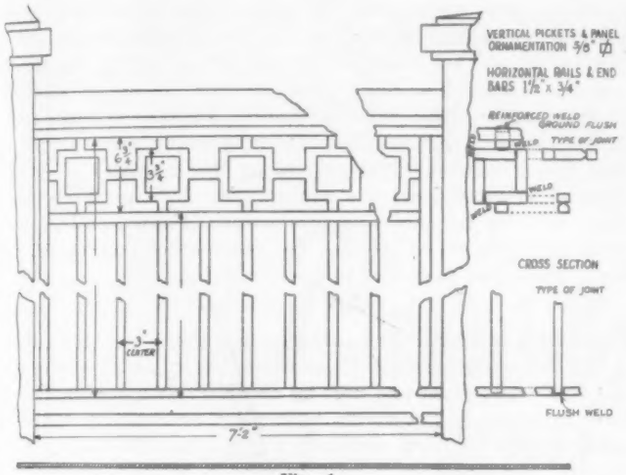

Fig. 1

The question was "Can you electric weld these without warping and save us money?" They purchased an arc welder and built the entire railing. As shown in Sketch No. 1, these sections were 7 feet, 2 inches in length, 3 feet, 1 inch high; the vertical pickets and panel ornamentations were 5/8-inch square bars; the horizontal rails and end bars were 1½ inches by ¾-inch flat bars. The pickets were spaced to 3-inch centers, making a total of 31 pickets per railing; the outside dimension of squares in panel was 3¾ inches.

The railing was assembled and lined up by being laid out on a bench in the customary manner and the ends of the pickets were tack welded in place, after which the railing was stood up and the finished welds were made in a flat position. The top ends of the pickets had a small reinforced weld which was afterwards ground flush and left a finished surface that showed no sign of where the weld or joint was made. The bottom ends of the pickets were made with flush welds. As this end of the railing is not seen, it was not necessary to grind it to get a smooth surface. In the panel portion of the railing where the squares were inserted it was necessary to make four welds at each square to hold them in place. The squares themselves were made by making four welds. The detail drawings in Sketch No. 1 will show the method by which the welds were made and also the type of joint. This type of joint was found strong enough for this type of railing.

The whole job showed a great saving over the old method of construction, that of tapping and screwing the pickets, and each section was completed in about one-third the time.

The figures below the sketch will give you some idea as to the cost of this job, but in addition to this there was a saving on the assembling of the squares which, as I stated at first, they expected to make of cast iron castings, the cost of which would have been twenty-five cents each or a total of three dollars and seventy-five cents for the 15 used, while the cost of making the wrought iron squares by electric welding was seventy-three cents, showing a saving of three dollars and two cents per railing.

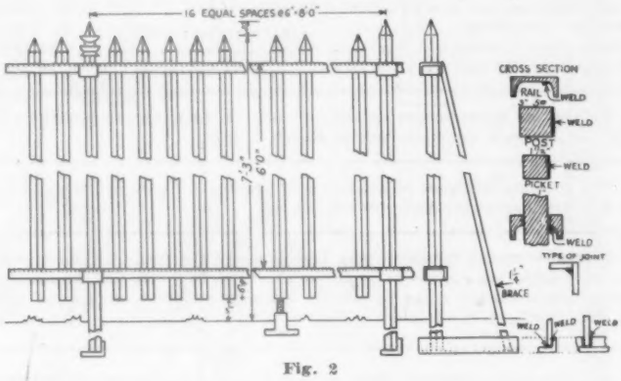

Fig. 2

This, together with welding the complete railing, turned what seemed to be a deficit of seven hundred dollars into a real profit.

Sketch No. 2 shows another job at the same shop—a picket fence made of 1½-inch square pickets. The regular method of assembling this kind of fence is by caulking (by hand) the pickets into the top and bottom channel irons. It takes two men one-half hour to caulk one section 8 feet in length. One man operating the metallic arc at 160 amperes and using 5/32-inch diameter electrode welded them in 20 minutes.

Sales manager, R. D. Thomas & Co., Philadelphia.

STANDARDIZATION OF THREADS USED ON VALVES OF COMPRESSED GAS CYLINDERS

On account of the importance of the ready refilling of cylinders for storing compressed gas, the U. S. War Department has requested the American Engineering Standards Committee to undertake the unification of threads used on the valves fitted to such cylinders.

The Department points out that probably very little inconvenience is caused where cylinders are used locally and always returned to the same company for refilling, but that "in the case of the War Department it is sometimes necessary to send these cylinders to points far distant from the plants of the company from which they were originally secured. Refilling is then a matter of considerable inconvenience, and it has been necessary in some cases to furnish special adapters for refilling." The letter goes on to suggest that there are probably a number of commercial companies whose operations cover a wide geographical area, which also experience the same difficulty in the refilling of their compressed gas cylinders.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

The Welding Engineer in Great Britain

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A Way to Save Good Welds

LONGITUDINAL welds in tanks, fabricated pipes, etc., are often subjected to severe abuse when the finished piece has to be hammered or pressed into shape because the welding operator has distorted it slightly from that of a perfect cylinder. It has been suggested that such welds should be slightly reenforced for an inch or so from the end of the weld so that there will be some extra strength at this point to resist the effect of such hammering in cases where such reenforcement does not interfere with the utility of the welded piece. Since it can be made at so little extra expense and trouble it sounds like a very sensible suggestion.

The Business Outlook

ALTHOUGH the present business tendencies may be somewhat discouraging to stock brokers, there is no indication that there is any actual business depression on the way. On the contrary, there is plenty of activity in ordering and plenty of business expansion on the way which points to a prosperous business year throughout 1925. There have recently been some cases of wage reductions which, upon close examination, were found to be actually beneficial by providing jobs for unemployed and by giving the employed enough increased working time to result in an actual gain in the weekly wage. One prominent business research staff points out that business is steadily growing more active as the Spring season advances and as the estimates of future demand in most cases are conservative it is not likely that there will be an excessive production. Consequently, there is ample evidence to warrant the expectation that we are in for a prolonged period of business activity.

How to Light a Torch—Use a Lighter

EVERY once in a while some mechanical genius pops up in a trade paper and uses up considerable space describing how to make a gas torch lighter by hooking up a spark plug, a push button, coil and a few dry cells on a work bench. We doubt if it will become a popular contrivance with welders until somebody invents a work bench which can be carried around in the overalls pocket, as there is a handy and thoroughly efficient gas lighter supplied with every make of equipment and obtainable at hardware stores for about fifteen cents.

What's Your Hurry, Boss?

IT is not unusual for a failed weld to be due to the customer or to the boss rather than to the welder's work. A good many parts are brought in to the torch or to the arc for repair for the sake of saving a great delay in operation which would be necessary if a new part were ordered. Then, not satisfied with saving days of delay those who order the work done proceed to kill the goose that lays the golden egg by insisting upon the greatest possible speed and even refusing to allow time for the job to be properly cooled before putting it back in service. The weld breaks and the welder gets the blame. It is up to him to stand by his guns and insist that the job isn't finished until it has had a chance to cool properly.

A Promising Field

OIL BURNING furnaces are becoming more and more popular for private home installations and if it gets to the point where the oil furnace is a real rival to the coal burner there will be a rich field for production welding of oil storage tanks suitable for the premises where such oil burners are installed. The design of tanks for this purpose should certainly call for all welded seams because there is no better insurance against leakage than a properly welded tank. Automatic seam welding machinery can well be expected to play

For quality and economy in oxy-acetylene welding and cutting there is no portable gas the equal of

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DISSOLVED ACETYLENE

THE PREST-O-LITE COMPANY, INC.
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PRODUCT
WORLD'S LARGEST MANUFACTURER OF ACETYLENE. THE GAS OF A THOUSAND USES
BATTERIES FOR AUTOMOBILES FARM LIGHTING RAILWAY SIGNALS AND RADIO

an important part in the efficient and economical production of containers of this sort.

More Savings Needed on Scrap Piles

A GREAT deal of the talk about wasted gas and wasted time in cutting is due to the fact that there is a vast amount of cutting done on scrap material and it is probably true that most uneconomical work is carried on in the cutting of various kinds of scrap metal. There seems to be a tendency to give the least amount of thought possible to the nice details of operation in cutting scrap material because it is scrap, whereas, the operators who are cutting metal for production are given very careful instruction, and every precaution taken to have the work as economical as it is high in quality. Undoubtedly, the cutter who is working on the scrap pile necessarily operates under a number of disadvantages which prevent him from making the speed and maintaining the low gas cost which is possible in the production shop or in the laboratory. But, many practical experiments in the field and experience of service men have shown that even on the scrap pile it is possible to accomplish considerable savings over present practice by giving a reasonable amount of attention to the factors which help the other fellow do better work at a lower cost.

A Tip for Salesmen

IN one of our leading magazines of business a shrewd buyer tells the following story:

> The other day a salesman came in to see me about handling his line of shoes. He didn't know much about the shoes, though, and he couldn't show me where I was any better off changing around and adding his line. That night I had to go down to the hotel to see a line of samples. I saw the shoe salesman in a big chair in the lobby. "What're you reading?" I asked him. "Ferguson's Bridge," he replied. "Huh," I said to him, "You ought not be a shoe salesman. You ought to be a bridge builder."
>
> But I'm afraid he didn't get the point.

Modern salesmanship is so dependent upon service that the experienced buyer searches out the salesman who is equipped to give him up-to-date information as well as merchandise. The welding salesman has plenty of opportunity to give this sort of service because there is a wealth of good reading matter in the welding trade papers and up-to-date books on welding processes; and users of welding are so anxious to be helped that no manufacturer's representative can afford to be a back number. Furthermore, if you keep an eye on what is going on in your industry you are constantly increasing your list of new prospects, new fields, and new applications.

A Rapidly Growing Market

ONE NEEDS only a brief investigation of industrial activity in and about the City of Chicago to realize that a tremendous market is accumulating here for everything. And that includes welding apparatus and supplies. Some of the big jobs which are either under way or contemplated include a $55,000,000 boulevard link, a $20,000,000 river straightening project, a $23,000,000 rearrangement of railroad facilities, $11,000,000 worth of new bridges, $95,000,000 for track elevation, two railroad stations aggregating nearly $200,000,000 $23,000,000 for elevated railway extensions, a $5,000,000 rod mill, a $350,000,000 harbor project, two stations totaling over $150,000,000, a $217,000,000 subway project. These and other large items which have recently been announced bring the total activity of this kind close to $3,000,000,000. As one writer recently said, Chicago is on the eve of a marvelous transformation and certainly deserves the attention of those who are looking for a growing market.

Good Railroad Welders Are Good Welders

A WHOLE lot of credit for the rapid development of good welding in this country is due to the careful and conscientious experimental work which has been done by railroad welders. They have had an opportunity to try out all the processes on practically every kind of metal and because of the necessity for safety precautions have made extensive investigations to bring about standardization of method and proper regulations for the application of all of the processes. Many of the railroad methods of testing and inspecting are worth careful study because they are so direct, so simple and so practical. It is interesting to note that they are continuing to develop each process to the limit and are very watchful against possibilities of failure as well as for possibilities of extending further the economies which welding means in an industry of that size. They have not always been given as much credit as they deserve. They probably would get more if we always stopped to consider that every man who has been fired from a railroad welding job is not an expert railroad welder.

MOUNTAINS OF WELDING FLUX

(*Continued from page* 29)

Bushings and bearings for heavy machinery made of these alloys of lead and copper have proven very efficient.

Welding Rods Containing Flux

In the course of their experiments it was noticed that both cast iron and copper after being melted with a small amount of the shale, combined readily with other metals, indicating that their shale might also be useful in welding. Thereupon some welding rods were cast, some of iron and some of copper, containing 5 per cent by weight of the powdered shale. Samples of these rods were given to several of the leading acetylene welding shops in Salt Lake and they were asked to try them without using flux, as the rods already contained the necessary flux. Without exception the welding shops reported them to be highly satisfactory. Mr. Lewis and Mr. Fisher were now satisfied that their shale had at last proven itself good for something, and they organized the Utah Metals Flux Company with a view to developing their claims.

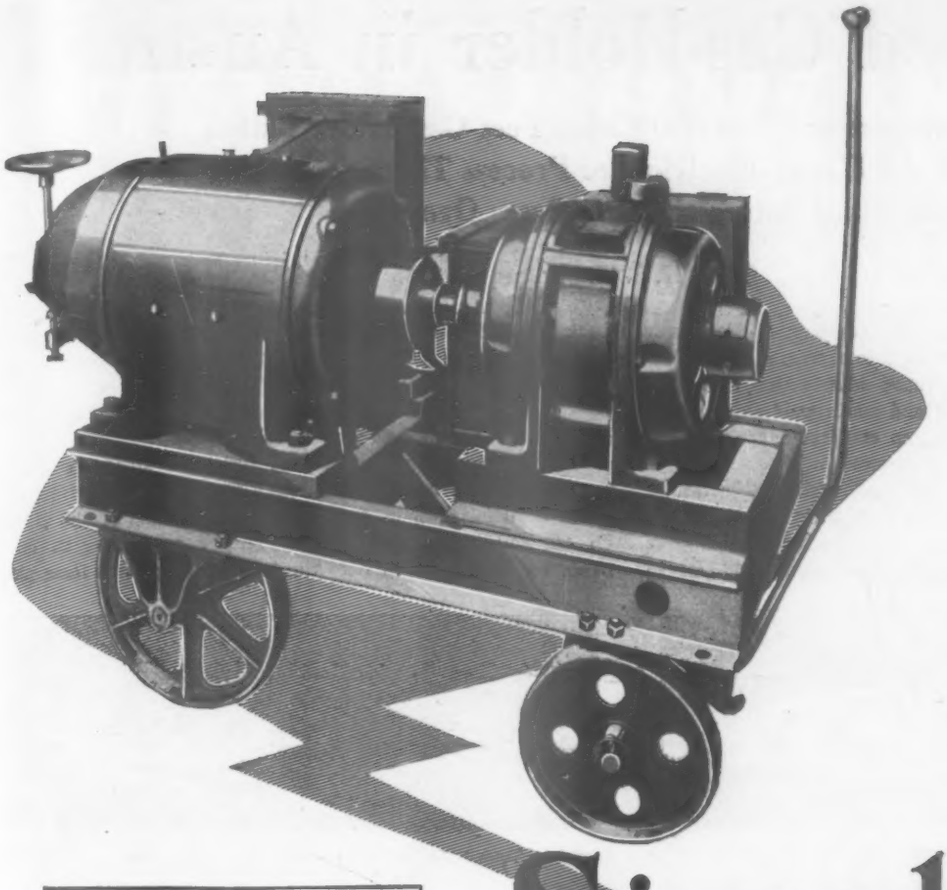
In the making of rods for acetylene welding, the natural shale just as it is mined, is crushed and melted with iron or copper and poured into rods. In welding with these rods no other flux is used and the welding of cast iron with a torch is said to be accomplished quite easily. With the flux treated copper rods excellent results are said to have been obtained in the welding of brass, copper and steel. The writer examined machine parts and cogs which had been rebuilt using both copper and iron rods. The welds are said to machine quite readily and to be very tough.

No steps have been taken by the Utah Metals Flux Company to enter into the manufacture of welding rods as they feel that a greater field of immediate usefulness for their product lies in its use for bushings and bearings. The usefulness of this natural shale for acetylene welding has been fully demonstrated however, and possibly at some future date this shale mountain in Utah will be called upon to furnish a few of its millions of tons of shale for that purpose.

ERNEST-MILWAY OXYGEN GAS TESTER

The Chicago Apparatus Company, 701 W. Washington Boulevard, Chicago, has just issued a bulletin concerning their Ernest-Milvay Gas Testing Apparatus. The apparatus especially interesting to the welding industry is the absorption type of Oxygen tester. This is furnished in two styles which are known as 1060C and 1070C.

In this new tester the pipette is so designed as to make it much less liable to breakage. The tester is complete and consists of a 100cc glass burette, 5cc of which is graduated in 1/10ths of 1 per cent; a special pipette in a special wide mouth bottle, mounted on a wood stand finished in black; leveling bulb with stand; connecting tube; and pinchcock.



Simplicity!

—a feature of the WD-12 Arc Welder

This welder is a two-unit machine—motor and generator. The generator is ***self-excited*** (an exclusive G-E feature). This eliminates a separate exciter which is a source of trouble.

Another exclusive feature is the ***reactor.*** This automatically steadies the arc under all welding conditions.

Complete regulation of welding current is accomplished by turning the handwheel on the generator. The enclosed magnetic switch provides safe and easy starting.

The arc is easy to strike and easy to maintain—all operators like it.

Ready to work when delivered.

The

WD-12 Arc Welder

—can be furnished for any commercial voltage, phase or frequency.

—delivers 200 amperes continuously and 300 amperes for short periods.

—voltage can be adjusted to suit work.

—any value of welding current between 75 and 300 amperes.

—all commercial sizes of electrodes, large or small.

—supplies power to G-E Automatic Arc Welder for continuous welding.

There is a suitable G-E welder for your every arc welding need. Ask the nearest G-E sales office for complete information.

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GENERAL ELECTRIC

All-Welded Gas-Holder in Australia

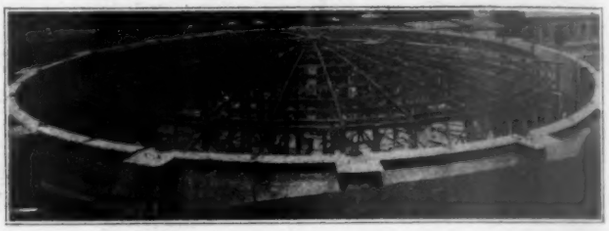
Construction of 2,750,000 Cubic Feet Gas-holder Called for the Use of Electric Arc Process Throughout —Many Interesting Problems Overcome

By C. H. S. Tupholme

ENGINEERS of the Metropolitan Gas Company of Melbourne, Australia have completed and put into service a 2¾ million cubic feet gasholder in which the entire construction is electric welded, eliminating drilling, riveting and smith welding.

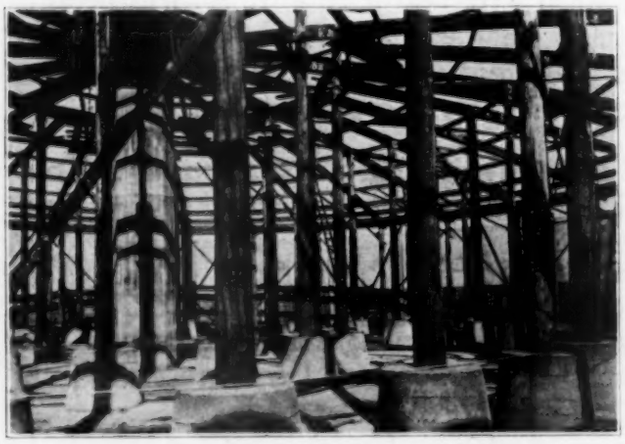
The new holder at Fitzroy has been constructed to take the place of one put into service about sixty years ago, which employed the old type of cast iron columns and guide pulleys, contrasting very markedly with the present day style of latticed guide standards, as used in the new holder. The old structure consisted of a single lift contained in a cemented brick tank 163 ft. in diameter by 25 ft. deep, and had a capacity of half a million cu. ft. of gas, so that the new holder has a capacity nearly six times that of the old.

Completed Tank for New Holder, Showing Completed Dumpling or Core

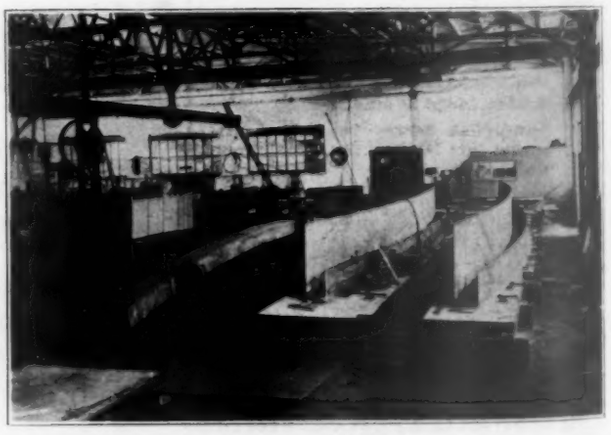


Complete Tank with Timber Framing for Crown Rest. Crown Center Plate Is in Position

To contain the new holder the tank had to be given a greater capacity, and this was done by raising the walls, making the tank 36 ft. 3 in. deep as against the original 25 ft., the work being carried out in reinforced concrete. While the work of raising the wall was in progress the dumpling or core was cut back and concreted. This had to be done to provide room for the four lifts. After the dumpling was completed the new center post and radial timber framing to support the crown of the inner lift when deflated were erected. The posts are rough-dressed and tied circumferentially by flat bars bolted to them diagonally.



Design and Construction of Posts Supporting Overhead Framing. Posts Set in Reinforced Concrete Blocks on Dumpling



Cup Ring Sections in Special Jig

In the new holder there are sixteen guide standards surrounding the floating bell, each in five sections, reaching to a total height of 144 ft. They are of the lattice type and are composed of two heavy steel 10 in. by 3½ in. channel sections front and back. These channels are connected by horizontal stiffeners composed of 8 in. by 6 in. H-beam section and diagonal bracing composed of 2½ in. by 2½ in. by ⅜ in. angles. The front 10 in. by 3½ in. channel acts as a guide for the adjustable face and side guide rollers attached to the four lifts.

At the extreme top of each of the guide standards wind tie brackets extend horizontally toward the center. They are composed of 6 in. by 5 in. by 25 lb. H-beams, and are 13 ft. long on the end toward the center. They have a plate 24 in. by 10 in. by ⅜ in. welded onto the bottom flange, and these plates carry a horizontal 4 in. by ½ in. flat bar welded to the plates at their ends, and are equipped with an adjusting screw, the nuts of which are welded to the flat bar. From the same plates run the diagonal wind ties, composed of 4 in. by ½ in. flat bar, with adjusting screws made in the same manner as the horizontal tie. The diagonal ties run from the plate on the lower flange of the 6 in. by 5 in. H-bracket back to the guide standards, and where they cross, are held by a clip to prevent chattering.

The nuts of the adjusting screws are soft steel castings screwed right- and left-hand, the coupling screws being 18 ft. 8 in. long by 2⅞ in. diameter. These are also screwed left- and right-hand. At the center of the body of the screw a flat is formed 2½ in. long, to take the spanner for tightening up.

At the top of each of the five sections of the guide standards provision is made for the attachment of the horizontal struts, for of which are built up from four 2½ in. by 2½ in. by ⅜ in. angles to form a box section 2 ft. deep by 1 ft. 6 in. wide, with 2½ in.

TOBIN BRONZE

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WELDING RODS

Photo courtesy Bastian-Blessing Company

A few cents more spent for trade marked Tobin Bronze filler rods, means a strong weld which can be easily machined, and which does not depend upon excess material for safety.

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by 2½ in. by ⅝ in. angle diagonal latticing. One is of the same form of construction but is composed of four 3 in. by 3 in. by ⅜ in. angles and 2½ in. by 2½ in. by ⅝ in. angle diagonal latticing. These struts were hoisted into place and welded in position by an angle welded to the top of the strut and the face of the guide standard. The bottom of the strut rests on an angle

Dip Plate Rings in Position on Holder

welded to the guide standard, and this also is welded to the strut so that the latter is held top and bottom at each end. In addition to these angle connections there is an angle strut running from the top of the horizontal strut to the side of the guide standard just at the rear of the 10 in. by 3½ in. channel which takes the guide rollers.

One of the Vertical Stays Showing Intermittent Welding on the 4x2 In. Channel

Each of the five bays formed by the guide standards and horizontal struts is provided with diagonal bracing, equipped with adjusting screws. The diagonal bracing in the bottom bays is composed of 12 in. by ½ in. flat bar; the bays above, 10 in. by

Method of Forming Curb with 12x3½ In. Channels and 6x6 In. Angle Ring

½ in. flats; the next, 7 in. by ½ in. flats; the one above 4 in. by ½ in. flats; and the top one, 3 in. by ⅜ in. flats. They are connected to the guide standards at head and foot by gusset plates ½ in. thick, set to take the bracers. These plates are welded to the guide standards, and the ends of the flat bars are welded to the plates. The nuts of the adjusting screws are welded to the other end of the flats, and connected with a right and left-hand coupling screw.

All the outside standards and framing, as also all the vertical stays and guides in the interior of the four lifts of this holder, were assembled and completely welded up in the shops, and afterwards assembled on the site with as few as possible service bolts to locate the various parts, prior to their finally being welded into position.

The floating bell is constructed in four lifts, each approximately 160 ft. diameter and 35' ft. deep. These dimensions give a height, when fully extended, of 140 ft. The crown or roof of the inner lift is convex in shape, with a rise of 7 ft. at the center.

Each of the lift sections is equipped with the usual water seal, consisting of cup rings at the bottom and corresponding dip plates at the top. The rings are formed of 12 in. by 3½ in. steel channels curved to radius and welded to ⅛ in. thick dip and skirting plates, all the remainder of the sheeting on the sides being ⅜ in. thick. The face guide rollers are 12 in. diameter with 4 in. face and fitted with cast iron eccentrics for adjustment.

There are sixteen vertical stays and guides in each of the four lifts, formed of 9 in. by 3 in. channels. These 9 in. by 3 in. channels have a 4 in. by 2 in. channel welded onto each flange for the whole length, and in these run the side guide rollers.

The 9 in. by 3 in. channel stays are welded to the skirting

Sections of Cups and Dips on Rest Blocks Inside of Tank

plates at the top and bottom of each lift. The inner lift has 32 vertical stays composed of two 9 in. by 3 in. channels placed back to back and spaced 5½ in. apart. These are connected together by eight 12 in. by 9 in. by ⅜ in. batten plates on each side, and at the head is a bracket composed of two ⅛ in. gusset plates and two 4 in. by 4 in. by ½ in. angles. These brackets are connected at their inner ends by a 12 in. by 3½ in. channel curved to suit the diameter and welded to the ends of the projecting brackets.

This serves to support the inner edge of the ⅛ in. thick curb plates which form the outer ring of plates in the roof. This ⅛ in. thick curb plate is welded at the outer edge to a 6 in. by 6 in. angle iron ring welded onto the skirting plate at the top of the inner lift side sheeting.

On top of each of the lift sections there are 16 carriages formed of 16 in. by 5 in. H-beams with angle brackets on the

faces for holding down and carrying the two adjustable face and side guide rollers, which run in the front channels of the vertical standard.

The skirting plates which form the top and bottom of each lift section with the cups and dips of the water seal are composed of 12 in. by 3½ in. channel bent to the required radius, the skirting plates, $\frac{5}{16}$ in. thick, being treated in a similar manner. These parts were assembled in a special jig for holding them in position when

Welding Side Sheets

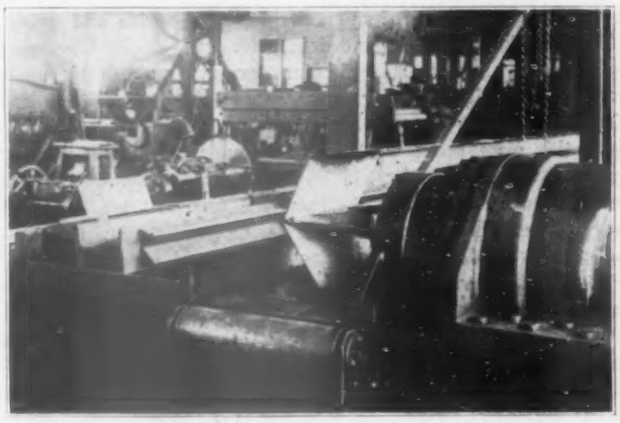
welding. The channel and plate were set up true in the jig and held in position by screws. While in this position they were intermitent-welded, then released from the screws, turned over, and the complete weld was made.

The cups and dips were welded up in sections, leaving only the joint where the several joints were butt welded when in final position. The sections were made in convenient lengths to handle, and as each section was completed it was placed in the tank on rest blocks. When set true it was clamped to the rest blocks and the abutting ends were welded together. The vertical stays were then set in position and bolted to the cup skirting plate. The dip with its skirting plate was next bolted to the tops of the vertical stays and welded at the abutting ends. Everything was then plumbed true and the erections of the $\frac{5}{16}$ in. thick side sheeting was begun.

This sheeting was assembled with four of the sheets bolted together, and then hoisted as one and bolted to the skirting plate at the top. When assembling the $\frac{5}{16}$ in. sheets to the top and bottom skirting plates, widely-spaced ¼ in. bolts were used in ⅜ in. diameter holes in order to give a certain amount of play, and so allow for adjustment of the plates for welding.

The operation of welding up the seams was as follows: The circumferential seams in each panel formed by the vertical stays were first welded to within a couple of inches of the vertical stays were first welded to within a couple of inches of the vertical seams, beginning at the top and leaving the bottom seam unwelded. The vertical seams were next welded and when these were done the corners of the intersecting sheets were welded, and finally the seam connecting the side sheets to the bottom skirting was completed. The laps of the sheets were fillet welded at the edges both inside and outside and each lift was completely welded before the assembly of the next one was commenced.

In welding up this $\frac{5}{16}$ in. side sheeting, owing to the size of the plates in proportion to their thickness, it was thought advisable



Method Adopted for Formation of Gusset Plates

to make provision to meet any contraction or buckling in the plates when they were to be welded, and this was done by wedging the sheeting out to a slightly greater diameter than the finished size, and welding all the vertical seams in this position.

The method of wedging was as follows: Horizontal beams were suspended by ropes at regular intervals with their ends engaging

Method of Attachment Between Horizontal Struts and Vertical Guide Standards

the 4 in. by 2 in. side channels, which were welded on the flanges of the 9 in. by 3 in. channel vertical stays and guides. When these horizontal beams were in place, 6 in. by 1 in. boards were placed against the sheeting alongside each vertical seam, and wedges inserted between these boards and the horizontal beams and

driven, thus forcing the sheeting outwards to the desired amount. When the ¼ in. diameter service bolts were withdrawn after welding, the holes were reamed and welded up. Sometimes it was found necessary owning to slight buckling of the plates, to bring the horizontal seam edges together, in which case a plank was used horizontally alongside these seams, and wedged out in the same manner as described for the vertical seams. The welding of the ⅜ in. plates was carried out simultaneously inside and outside.

The sheeting when assembled in place was welded together in eight radial segments, the circular seams first, then the radial seams, and finally the long radial seams of adjoining segments. Finally the plates were welded to the top curb of ⅜ in. thick plate, this plate being welded to the outer 6 in. by 6 in. curb angle, and the 12 in. by 3½ in. channel ring, which is carried by the brackets formed on the inner lift vertical stays. All bolts used for assembling the plates were withdrawn as the welding of the curb proceeded and the holes reamed and welded up.

To afford access to the various lifts, stairways were provided on the outer circumference of the guide standards. A ⅛ in. checker plate gangway is provided on the horizontal struts between the two guide standards at every level, the total length of the gangway being 11 ft. 8¼ in. long by 17 in. wide, resting on the horizontal struts. At each end is a checker plate landing, 3 ft. 9 in. by 3 ft. 4½ in., projecting outwards, the landing at one end receiving the head of the ladder below, and the other taking the foot of the ladder leading to the next landing above. The total vertical height from landing to landing is 28 ft.

The handrailing round the landing and gangways is formed of 2 in. by ¼ in. flat bar welded to a 2 in. by 2 in. by ¼ in. angle standard, which, in turn, is welded to the main structure. The ladder itself is formed of 9 in. by ½ in. flat strings, with 6 in. by ⅛ in. checker plate treads 1 ft. 9 in. wide in the clear, and have ¾ in. diameter gas barrel handrails and standards, the ends of the standards being flattened to allow for their being welded to the 9 in. by ½ in. strings. The vertical ladders are formed from 3½ in. by 2½ in. by ⅜ in. angles, 25 ft. 10⅞ in. long, with ⅝ in. diameter round, welded onto the face of the angles. In conjunction with the ladders and landings, and in order to allow access to the various lifts, landing stages are provided on each lift, composed of 2½ in. by 2½ in. by ⅜ in. verticals, and 2 in. by ¼ in. flat handrails, and ⅛ in. checker plate floors. All these are welded to the various lifts.

In the case of the inner lift, the stage is welded to the crown of the holders over the curb plate, the second and third are welded to the dip rings, and the outer lift has a checker plate welded to the dip ring. Their mode of action is as follows: When the bell is fully extended, these telescopic landings register with their respective landings on the guide standards. As the bell sinks, the inner lift landing sinks onto No. 3 lift, and is sufficiently long to reach over No.'s 2 and 3 lifts. As before stated, the No. 1 or outer lift, has a checker plate only, thus forming a direct means of communication with any one of the four lifts and the landings.

For the erection of the guide standards and the general handling of material during erection, an ingenious form of gantry crane was designed by the chief engineer in charge of construction. This crane was of the revolving or trammel type, having one end pivoted at the center of the crown rest framing. The outer end of the gantry, carrying the electrically-operated hoisting, luffing and traveling gear, the housing and jib, traveled on a single rail, supported on ties laid on the circumference of the crown rest framing. Part of the track was lifted to allow welding up the crown plates at that point, the track afterwards being replaced.

Two jibs were used, one 50 ft. long to deal with general handling and the lower sections of the guide standards and horizontal struts. The other jib was 100 ft. long and took care of the highest lifts of the standards and struts.

The whole of the gantry and the jibs were of lattice construction and were welded throughout the same process as was used on the holder construction. The 100 ft. jib was made in three lengths, bolted together by turned bolts, and it is interesting to note that these were the only holes in the whole structure. The radius of the long jib was from 20 ft. to 25 ft., and lifted at a time two top guide standards, weighing 2½ tons.

By means of this crane and jib the erectors were able to erect four lengths of vertical guide standards and four horizontal struts per day of 8 hours. When this jib was in use, deflections both ways were carefully noted when the jib was carrying 2½ tons and the deflections were less than ⅛ in.

It was originally estimated that it would take 30 men 20 weeks to erect and rivet this holder by the ordinary methods, whereas it took 20 men 16 weeks to complete the job, eight of the men being welders. The total weight of steel in the structure is 760 tons.

Tests conducted during the progress of the work showed that the welds were as strong, as and in some cases stronger than, the original plate, the breaking stress being 30 tons per sq. in. Under the microscope the steel of the joints showed a similar, but finer, grained structure to the original steel of the plate, and, which was most important, the plate was in no way adversely affected by the welding operations.

The holder was designed by and constructed under the supervision of J. N. Reeson, M. Inst. C. E., and his assistant, H. E. Groves. All the work was carried out in the Metropolitan Gas Company's own shops at Melbourne by the local staff, the welders being trained in the use of the welding process which employs the special electrodes developed by the Quasi-Arc Company of Great Britain. The holder has now been completed, and, on test, no leak was found in the entire structure.

Gas plant constructional engineers in Britain have followed the enterprise of J. N. Reeson and his staff with considerable interest, and are employing this welding process for carrying out repairs to holders and similar containers, though as yet no holders has been completely welded as in the case of the Fitzroy gasholder in Melbourne.

NEW REGO TORCH

The Bastian-Blessing Company of Chicago, Illinois, have recently announced a new torch in their line of oxy-acetylene welding and cutting torches. This is called the Rego Automatic Shut Off Torch. The shut off device enables the operator to put out the flame by pressing a button at the forward end of the handle.

New Rego Automatic Cut-Off Torch

When he gets ready to weld again the button can be released with a light pressure and the torch lighted, giving the same flame adjustment which was used before the welding stopped. The manufacturers point out that this device results in a considerable saving of gas because it is not necessary to have the torch burn gas when it is not welding or to spend time adjusting the valves between operations.

HEARINGS IN CONNECTION WITH WELDING RODS OR WELDING IRON

Hearings in connection with Docket No. 22 of Consolidated Classification Committee (Official, Southern and Western Committees) will be held as follows:

New York, N. Y., beginning April 14, 1925
Room 408, 143 Liberty Street.
Chicago, Ill., beginning April 21, 1925
404 Chicago Union Station.
Atlanta, Ga., beginning April 29, 1925
Room 1015, 101 Marietta Street.

The above subject docketed account application to this Committee for change in ratings in Official territory is on Docket 22.

Welding Operations On the Wabash

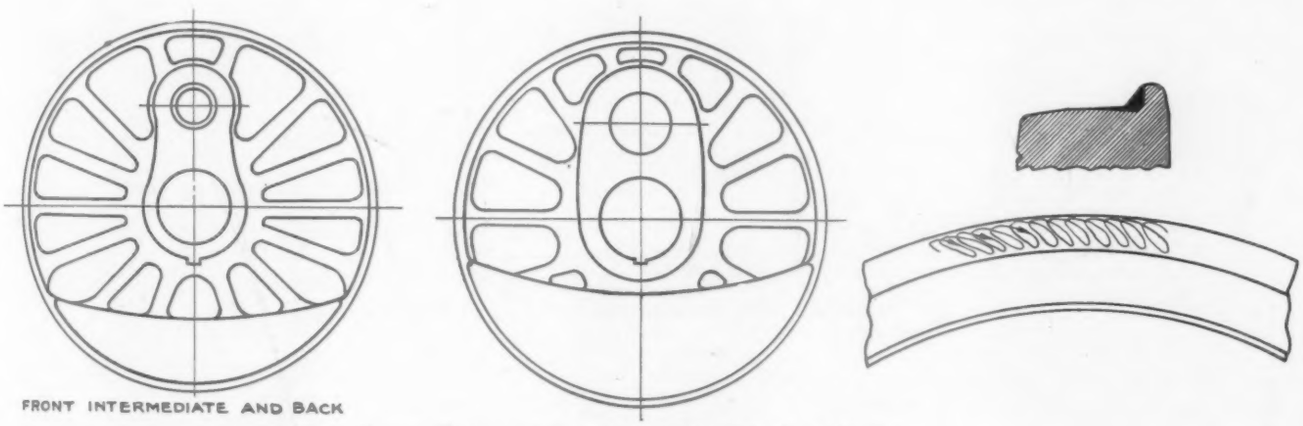
Welding Operations Standardized—Rules and Regulations Are Enforced—Complete and Intelligent Records Are Kept

By J. A. Heaton

BEFORE the strike in 1922, the welding on the Wabash was handled in the same manner as the other roads, that is, each craft had their own particular cutters and welders. These men were not allowed to do work for any other craft. They were under a penalty of a fine if they did so. This system not only caused confusion but was not satisfactory in any respect.

It was amusing at times to see several workers belonging to different crafts waiting for a cutter when one would be standing looking at them but could not do the work, just because he belonged to another craft. The blame could not be placed on the cutters but on their unions.

During the strike, Mr. George F. Hess, our Superintendent of Motive Power, decided to establish a welding department which would place all welders and cutters in a craft by themselves on the same basis as the other crafts.



Shop Card Diagrams for Welding Driving Wheels and Tires

This system is unique in two respects from other roads; first, that it embraces all classes of autogenous welding, electric, acetylene and Thermit. Second, that any cutter or welder can do work for any craft in the shop. Some of the roads have established welding supervisors who look after the work as done by the different crafts, or, have placed the electric arc welding under the supervision of the Electric Dept. While this was a step toward improving the welding on their roads, it does not embrace all branches of welding. It must be taken into consideration that there is a place for all branches of welding on railroads and to obtain the utmost from these processes, they must be classified under one head. By having the welding in one department, the supervisor may change from one process to another without having to "buck" another party and each process can be handled impartially.

To get the full benefits from welding the entire welding operations were standardized. Each operation was studied and the method and process alloted to it. A standard practice card is made of the job showing the method, and the most important work, such as, cylinders, frames, wheel centers, driving flanges, boiler work and etc., is shown on a print and a record is kept of same. The ARA and ICC specifies that the operator stamp his name, date and shop name on such work, but it is an easy matter to destroy these letters, while a printed form may be kept straight.

To get an idea how the system effected the welders before the strike can be seen by the following:

Seven months after the strike we employed three welders who were with us before the strike. One was a machinist, one a blacksmith and the other a pipefitter. Before the strike these men were first-class welders in their different lines but could not handle work for the other crafts. The machinist could not handle steel satisfactory and the blacksmith could not work cast iron and while the pipefitter is the best welder on superheater units and brazing copper pipe that I have had the occasion to meet, he could not handle either steel or cast iron welding except in small work. After handling work for all crafts for one year they are proficient in all trades and are capable of keeping a job in any shop either railroad or commercial.

It can be seen that the unions would not let the men improve beyond a certain stage, while with the system which we now have on the Wabash, it not only improves the men, but we get a better grade of work. We find that if we help the men and keep them satisfied we will get better results and more work.

We take our apprentices from the helpers in the shop; these helpers must have two years experience before applying for the welding department. All apprentices of the different crafts have the privilege of applying for training in the welding department. These are placed with first-class cutters for several days until they are familiar with the outfits and are capable of acting quickly in case of an accident. They are then assigned an outfit which they keep and they are held responsible for the upkeep of it. They are placed with one craft and stay with them until proficient in their cutting, which usually takes about three months. Then they are transferred to another department. After cutting for one year, they are transferred to the welding department for instruction and welding for one year. They are then sent to the pipe shop for six months, after which they are placed on the floor to take care of any welding or cutting jobs which may turn up. By placing them on the floor for the last six

months we find that they will gain confidence in their work and are able to handle their work better. All welders and apprentices are required to furnish a test plate each month. While there are some objections for the straight line pull test, we test our plates by the kerosene test which gives a very rigid inspection of the plate.

In placing the first-class men with the different crafts we always place those who are thoroughly familiar with the work pertaining to that craft, not only to keep the work up to the highest degree of efficiency but also to be able to instruct the apprentices placed in that department. While the welding supervisor has charge of all welders and cutters, they are also under the orders of the foreman of the department in which he is working. There are so many small jobs which turn up during the course of a day, that if he had to hunt up the welding supervisor to have them done, his work would soon fall behind. The supervisor inspects the work and sees that their outfits are kept in good condition.

The human side is sometimes found to be more important in getting out the work than the old hard rule of "do it or get out." While we do not uphold the men in any wrong doing, each case of disagreement is taken up and sometimes we find that a man can give us more work in one department than he can in another, or sometimes a foreman will take a dislike to a man. These conditions are all looked after and are so arranged so that all are satisfied.

A tool repair shop is maintained which takes care of the entire system much in the same manner in which the main locomotive shop takes care of the locomotives. Each shop on the system is equipped to take care of all minor repairs such as packing valves, etc. Each operator has strict instructions not to do any repairs whatever to his torches or regulators. When any tool requires new parts, they are shipped to the tool repair shop for renewal. When a torch or regulator is repaired it is stamped with the date it is repaired and a strict record is kept of same. We find that in keeping this record and putting the date on the torch, that the operators will take more interest in their equipment and it needs less repairing. It is almost unbelievable that we have torches that have been in constant use for fourteen months.

While we do standardize on equipment we are always ready to change to anything which we find is better than that which we are using. At present we use only the hand welding and cutting torches and for arc welding we have the 200 and 300 ampere single operator direct current machines.

We are very conservative in boiler welding and we conform strictly to the ICC and the ARA rules and the following rules are followed in each shop:

1. Welding will not be permitted on any part of a locomotive boiler that is wholly in tension under working conditions. This is to include arch or water bar tubes.

2. Stay-bolts or crown stay heads must not be built up or welded to the sheet.

3. Holes larger than 1½" in diameter when entirely closed by autogenous welding, must have the welding properly stayed.

4. In new construction, welded seams in crown sheet will not be used. This is not intended to prevent welding the crown sheet to other fire-box sheets. Welding in patches on crown sheet is not permitted. Side sheet seams and other welded seams in any part of fire-box shall not be less than 12" (18" preferred) below highest point or top of crown sheet.

5. Where autogenous welding is done, the parts to be welded must be thoroughly cleaned and kept clean during the progress of the work.

6. When repairing fire-boxes, a number of small adjacent patches will not be applied, but the defective part of the sheet will be cut out and be repaired with one patch.

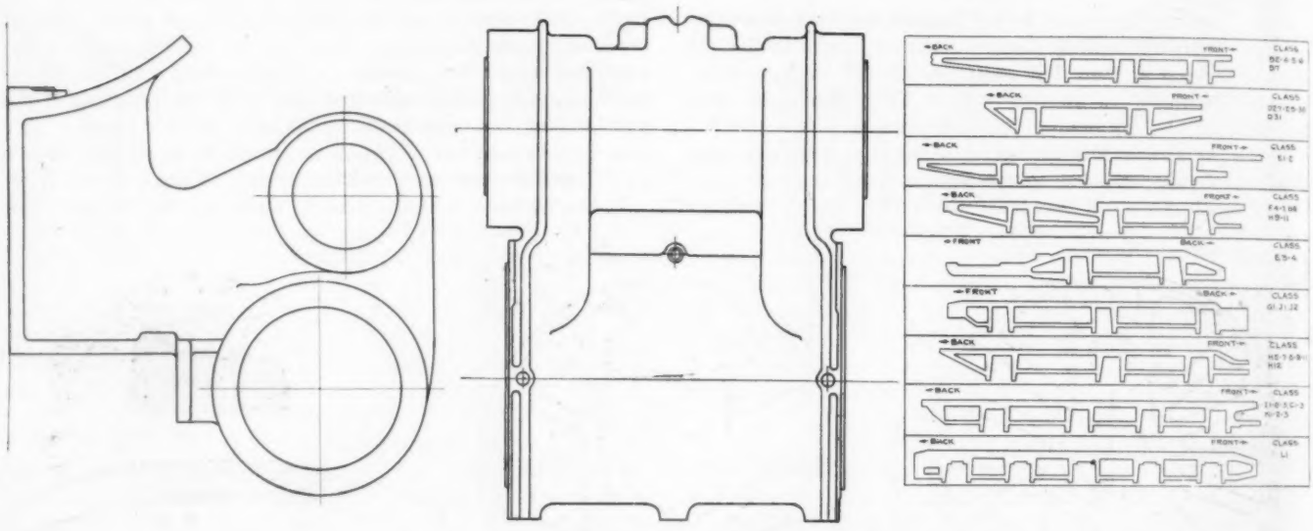
7. The welding in of patches, building pitted or grooved places and cracks in back head sheet or boiler head is not permitted.

8. The welding of a defective main air reservoir is not permitted.

Record of all boiler welding is kept on a form showing where the weld is made and by what operator. Although we follow up all welding, we take more pains with the boiler welding. All seams are laid out by the straight edge and are cleaned and bolted in place before the welder starts the operation. All small patches are cut to either an oblong or diamond shape. After the welder has finished, the job is completed. We do not chip and bob in the welding. If the welding could be hammered in while red hot, it would improve the weld, but after the weld is cold, it only closes the pin holes and does not strengthen the weld. If any leak develops when the test is applied, it is cut out and rewelded. This not only keeps the welders at the highest point of efficiency, it also saves considerable time and labor of chipping.

The electric arc is used for all boiler welding.

(To Be Concluded)



Shop Card Diagrams for Welding Cylinders and Frames

Welding in Pipe Coil Manufacture

Continuous Length, Required in Iron Pipe Coils for Heaters and Refrigerators, Calls for Wide Use of Butt Welding

IN the manufacture of pipe coils butt welding has come in for an important and constantly growing application. The refrigerator field has long been recognized as fertile ground for welding, and the trend in modern home architecture, specifying as it does, individual ice cooling plants, indicates that this field may grow even larger. But the manufacture of refrigerating equipment is not alone in the demand for pipe coils and the consequent need for butt welding.

The Rempe Company, of Chicago, presents an admirable view of the scope of pipe coil application. This company for a number of years has been engaged in the manufacture of iron pipe coils of all sizes and shapes, for ice and refrigerating machines, cold storage houses, chemical works, blast furnaces, soap factories, feed water heaters, car heaters, and—this is a recent innovation to the line—ornamental pipe signs and designs. The company's advertising slogan is "coils of any shape or description in any desired continuous length."

Types of Pipe Coils Requiring Butt Welding

It follows naturally that in production of such proportions an appreciable amount of welding is necessary. While it may be admitted that the most interesting feature of the Rempe Company's production is the bending of the pipe by special machines, it must be remembered and appreciated that "continuous length," where the stock used comes in 40 ft. lengths, can be realized only through smooth and secure fusion of successive lengths. The majority of the work done at this plant is with 1¼ inch pipe, although considerable business is had in stock ranging from ½ inch to 3 inches in diameter. The joining of these lengths is accomplished with automatic butt welders.

Electric resistance welding has a wide variety of applications in modern manufacture, but just as these applications are many and varied, so also, are the variations of the process, itself, very numerous. In the matter of butt welding there are a number of systems, each particularly suited to a certain type of work, and only through careful experimentation it is possible to select the proper kind for local and specific requirements.

This has been the case in the manufacture of pipe coils. The method now employed at the Rempe plant is one which has been derived after many trials under varying conditions of material, temperature and pressure. One of the factors making for good smooth welds in pipe coil work is the condition of the stock. Butt welding is generally defined as the process of uniting wires, rods, bars, plates, tubes or pieces of similar shape, transverse to their length. When the pieces have the same cross sections the chances of a superior weld are higher than when the cross sections are unequal. This condition obtains, of course, in pipe coil manufacture, where the pipe lengths used in any one coil are all indentical. Ordinarily butt welding does not require any great amount of careful preparation, as compared to other types of welding, but it is a fact that clean stock—stock which is not rusty nor scaly—welds more easily and quickly and at a lower tax on the power of the machine. Here, again, pipe coil manufacture possesses a feature conducive to good welds in that the stock is new, and the ends are cut sharp and clean.

The matter of proper temperature and pressure must also be arrived at through experimentation and close observation. Authorities hold that in butt welding the surfaces in contact and the metal in the immediate vicinity of the weld should not be heated much higher than 2400 deg. F., and that the current should not be applied any longer than is necessary to bring the metal immediately behind the surfaces to be welded to the welding heat. The temperatures for different metals vary, and iron, which quickly changes from a solid to a fluid when raised to high temperatures, does not require the maximum amount of heat. At the Rempe plant the majority of the welds—those in the 1¼ inch pipe—are made at a temperature of about 2200 deg. F.

Length of piece which is heated is another important item in butt welding, the greater the length of the pipe beyond the clamps, the greater the amount of heat needed and consequently, the higher the temperature at the point of contact. Rempe pipe is clamped in the jaws of the machine with only about 1½ inches protuding—that is, each clamp is about 1½ inches from the weld. The actual time of heat application is not much in excess of one minute, and very little pressure is exerted through the clamps. Light blows of a hammer, however, are administered at the point of weld while the surfaces are fusing, making the weld essentially like that done in a smith shop.

Where high current is applied for a comparatively long period

in making the weld, a considerable amount of clamp manipulation is attendant. This is to supply the necessary pressure. In welds of this type there is usually a heavy flash around the welded sections. This entails much decarbonization of the steel in the vicinity of the weld, and the structure of the weld, itself, is likely to be irregular and faulty, a condition which may be somewhat remedied by annealing.

The flash weld, as it is ordinarily understood, is a butt weld, quickly made, starting with light contact pressure, followed by a period of sparking with no pressure applied, and finished with heavy pressure. The amount of heat used in making such a weld is generally enough to melt part of the metal and produce a burr on the weld. Ordinarily this type of weld is strong and resistive, but the burr needs to be chipped off and the welded piece probably machined or ground. Since the pipes proceed immediately to the furnace and bending machines from the welder, there is no chance for grinding here, and after the coil is made the shape prevents any possible grinding or machining. Consequently, the flash weld is not well suited for joining pipe lengths for such purposes.

Ornamental Signs Made From Welded Pipe Lengths—Find the Welds

A type of weld which is considered by many to be superior to the flash weld is the upset weld. This is a butt weld made with only enough heat to bring the pieces to a welding temperature, and executed slowly with a comparatively large amount of pressure. The result is a bulged portion, or upset, at the point of welding, and while this upset is credited with having a tough and durable section, it must be ground or machined if the finished article is to meet certain requirements of appearance. This is the case in pipe coils. The welds in these coils, while they cannot fail to be detected on close inspection, do not appear as conspicuous irregularities in the pipe. These welds are such that the impression of "continuous length" is practically complete.

It may be thought that the type of weld used in the manufacture of these coils sacrifices much in the matter of strength, when compared to the flash or upset weld, but the weld used is adequate for the purposes. In addition to securing the desired appearance without the need of machining, this weld proves itself capable almost immediately upon leaving the welder. As mentioned before, the welded pipe proceeds from the welder to the bending machines. The pipe is passed through an oil furnace for the necessary heat treatment. It is brought up to a cherry red and as it comes out of the furnace it is turned on drums into the desired shape. The welds must withstand the strain of this bending operation just as any other section of the pipe, and the welds do withstand it.

The coils manufactured by the Rempe Company are all tested hydraulically, some being tested with a pressure as high as 2,400 pounds, but all guaranteed to withstand 500 pounds. Needless to say, the welds must pass the test as well as any other section of the pipe.

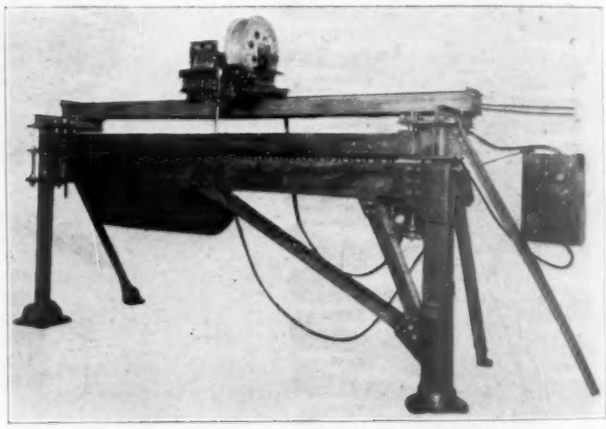
Acetylene welding also plays a part in the manufacture of many of the Rempe coils. Some of the spiral heater coils have interior stems, as shown in the illustration. The stem is made on the outside of the coil in the regular bending process, and in cases where the coil is to have an internal stem, the gas torch comes into play. The stem is cut off at the bottom, and after slight bending of the end of the coil for the purpose of securing a good fit, the stem is placed inside the coil and welded (with the torch) to the end of the coil from which it had previously been cut. Occasionally the heat treatment of the spiral furnace reveals flaws in the pipe. These are filled and repaired by the use of the gas torch. Still another form of welding is in use at the Rempe plant. This is the smith weld, and is employed in welding the heads of ammonia drums.

Ornamental signs were originally made as a "trick," intended for home purposes, but this kind of sign is becoming so popular in restaurants, stores, and markets, that the manufacture of them promises to claim an important place in the pipe coil industry. Many of them are made in the smaller sizes of pipe, but with the ornamental stands and designs that go with them, (all made of pipe) considerable welding is entailed here, too.

NEW G-E AUTOMATIC WELDER

Following several years of development and trial, the General Electric Company is now marketing a line of automatic arc welding equipments. These equipments, sold either as complete units or as separate parts, have been especially designed for quick, efficient and economical welding where quantity production is a factor. Heretofore, it has been the custom to supply the separate parts only.

The new outfit is expected to find its principal application in the construction of such standard products as tanks, boilers, cans, axle housings, and pipe, and also for repairing undercut shafts or axles and building up sharp flanges on car wheels. Its field



General Electric Automatic Tank Welding Machine Incorporating Arc Welding Travel Carriage, Pneumatic Clamps and Swinging Arm for Holding Tanks.

of greatest usefulness will be in the manufacture of storage vessels where the static load is not greater than 10 pounds per square inch and where the thickness if the metal to be welded is not less than No. 16 gauge.

Outstanding among the advantages claimed for these automatic equipments is the resulting increase in speed of production following their installation. A complete outfit can be operated by a man and helper, while the completion of an equal amount of hand work in the same time would necessitate the use of four or more men. Estimates also indicate a lower overhead expense than with gas welding, excluding the item of labor. The use of pushbutton control provides simplicity and ease in operation. Uniformity of finished product and space saving by the reduction of the number of workers and quantity of stock on hand are among the other advantages claimed for this equipment.

A complete outfit consists of an automatic welding head and control panel, travel carriage and clamping device. Where it is desired, in order to meet special circumstances in any plant, the travel carriage and other component parts of the equipment may be assembled by the purchaser with his own device for holding the work.

A list of products in the manufacture of which this automatic equipment is recommended includes ice cream cans; gasoline stor-

age tanks; oil switch tanks; transformer tanks; range boilers; and pipe for dredging, oil well casings and irrigation purposes, and textile machinery parts. Automatic equipments are also recommended for repairing worn car wheel flanges, locomotive guide rods and worn axles and shafts. Several successful installations have been made by street railway companies both in the United States and foreign countries.

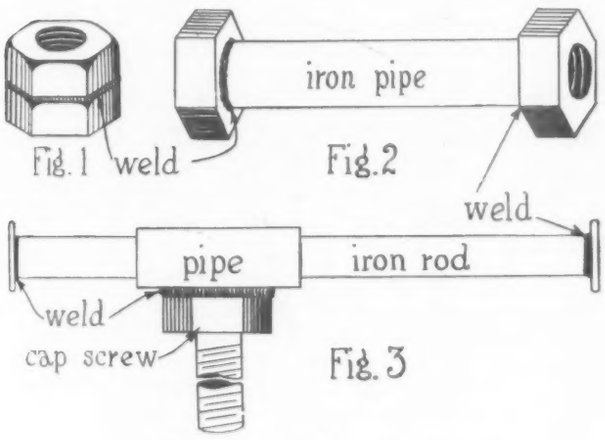
TORCH TALKS*

By Edwin Kilburn

**Torch Talks is the record of the doings of a small town welding shop and, while not claiming perfection for the method of doing such jobs as are described, the writer wishes to state that every detail described has been tried in actual practice and is known to be successful.*

Machine designers are occasionally guilty of placing stud bolts, etc., in rather inaccessible places and the job of tightening the nuts with ordinary wrenches is often almost an impossibility. Special wrenches are very often A. W. O. L. when they are most needed and some comparatively inexpensive method of providing for the operation of these nuts with any wrench is very desirable.

Figures 1 and 2 show two methods of making the nuts accessible, the welding torch being used with either method, Fig. 1 shows two hexagon nuts welded or brazed together to bring the nut far enough away from the casting to allow the wrench to fit, in making use of this plan it is best to screw the nuts on a threaded rod in order to preserve the alignment of the threads, care being exercised to remove the rod after the nuts are tacked together.



When Nuts Are Hard to Operate

Figure 2 shows a variation of the same idea, this plan being used when two nuts welded together will not give sufficient clearance for the wrench. In Fig. 2 the two nuts are separated by a piece of iron pipe of suitable length, a nut being welded to each end of the pipe.

In many mechanical devices ordinary cap screws are provided for making necessary adjustments and it is necessary to use a wrench every time an adjustment is necessary. Fig. 3 shows a method of easily providing handles in places where cap screws are used for adjusting purposes. A piece of iron pipe or steel tubing is welded to the head of the cap screw, a piece of iron rod of suitable length is placed in the pipe, a small raised ring made at each end of the rod by welding as shown, and a very satisfactory handle is produced at small cost.

During the past year the writer has experimented extensively with a well advertised method of brazing cast iron and has found it very satisfactory in quite a variety of jobs, cast iron crank cases damaged by reason of a connecting rod going through the wall being one class of repairs where this method is very useful. On a very recent job a crank case was delivered to us with an opening approximately 2"x3½" and the piece broken out lost. A patch of $\frac{1}{16}$" steel cut to fit roughly in the opening was first made, then the case was placed on the welding table, the preheater played upon it until the whole case was about hot enough to melt solder, the patch was then brazed in place, and the job proved to be entirely successful. By the brazing method much less heat is required both for the actual brazing and for the preheating than is necessary in these jobs on complicated castings when welding is resorted to, and there appears to be very much less danger of cracking than by the welding method.

HEALTH HINTS FOR WELDERS

It is a well known fact that oxygen and acetylene gases generally used for welding and cutting are not poisonous, in themselves; and when these gases, charcoal, or fuel oils are burned under proper conditions and in the right proportions, there are no injurious fumes given off. The welder's troubles are really caused by the unavoidably incomplete combustion of charcoal, grease, paint, etc., giving off pungent and poisonous smoke; and the vaporization of chemicals in fluxes and the distillation of metals. Yet the welder is often unconscious of the danger until after effects show themselves. This is easily explained, however. The welder is wearing goggles and can't see the smoke, and his sensory nerves are temporarily out of commission. Another reason is that when a welder is engaged at an important welding job he is like a "one man orchestra." All his faculties are concentrated and co-ordinated on the work, unconscious of what is going on about him. It's nothing to be surprised at, when the welder finds himself physically and mentally exhausted after an important welding job. Yet, much of the welder's hazard is avoidable. A large workshop with high ceiling, well ventilated, and the use of a suitable respirator and arranging any draft condition to carry fumes away instead of toward the welder.

The effects of brass chills attack the victim on retiring. The symptoms are drowsiness, shortness of breath, cold hands and feet. The room seems to lack air, and you find it almost impossible to get to sleep; and when a restless sleep finally comes, it is disturbed by a monotonous dream, which is repeated many times during the night, ending in bodily perspiration toward morning. If you possess a good average constitution, you can drink two glasses of pasteurized milk and take a brisk walk and all ill effects will have disappeared, that is, the next morning. Brass chills are caused by breathing the fumes of copper, brass, bronze and galvanized iron.

A welder should know what his flux contains or buy it from a responsible firm. If a flux causes the nose to run or tears to flow or causes excessive sneezing there is something wrong. The smoke and fumes of paint, grease, and charcoal, if too strong will render the welder suddenly unconscious and we can realize what this means if he is working over a fire with a lighted torch in his hand and no one around to help him. In most cases, however, the welder only gets a severe headache which passes off without having any visible permanent effects.

THERMIT WELDING LOCOMOTIVE FRAMES

A Correction

It has been pointed out that several items in the article on Thermit Welding Locomotive Frames, which appeared in the March issue of *The Welding Engineer* are either stated in such a way as to be open to wrong interpretation or directly contrary to what is considered the best modern practice. The following comment is therefore submitted as a correction for the above mentioned article.

The explanation of the oxidation of iron is hardly scientific and hardly explained the function which the combined oxygen in iron oxide plays in Thermit welding. The important

point, of course, in the Thermit process is that the aluminum has a much greater affinity for oxygen than has iron and that the heat of reaction between aluminum and oxygen which tends to be disassociated from its iron compound and associated with the aluminum is so great as to bring the entire mixture to a temperature of approximately 5000 degrees Fahrenheit.

The explanation of the addition of punchings and nickel shot makes it seem as though the Thermit user had to go to all this trouble himself, whereas in reality Railroad Thermit is furnished ready for use.

The spreading of the frame is likened to the opening required for an acetylene weld, which may lead to trouble because the acetylene opening must be V shaped, whereas the opening for the Thermit weld has parallel sides. The figure illustrating the opening in the cut may help to correct this impression.

The description of the ramming of the mold, saying that it must be done carefully so as not to scar the wax is very apt to cause loosely rammed molds and poor porous welds. In actual practice the molding material is rammed hard after the wax is hardened to a point to withstand such severe ramming.

The use of sand next to the wax with less expensive molding sand used for backing is not in accordance with the standard practice. Thermit engineers advocate the use of molding material throughout the mold because of its porosity and the use of a backing material which is less porous will affect the weld. It is true that they allow molding material to be reused as backing with fresh molding material as facing, which may be what the author had in mind. The instructions to allow the finished mold to stand overnight are directly contrary to good practice.

The running of vent holes in such a way as to insure touching the wax is also directly contrary to instructions and all such vent holes touching the wax are absolutely useless. The statement that it is permissible to put in vent holes through the sides of the mold, provided their outlets are not more than 4 inches below the top of the mold is dangerous, unless the instructions are amplified by saying that none of these outlets should be below the level of the pouring gate or riser. It is especially dangerous since in the next paragraph it is stated that these vent holes should also touch the wax.

The description of the reasons for drying out the crucible and the method recommended of doing it can be improved by following standard instructions.

In the next to the last paragraph the author advises leaving the spreading block or jack on the frame for at least two and a half hours after the weld is made. Instructions are that it shall not be left for more than a half hour and preferably only fifteen to twenty minutes. This error is probably the most serious in the whole article.

A special book of instructions on locomotive welding by the Thermit Process has been prepared by the Metal and Thermit Corporation and serves as a reliable guide to the up-to-date application of the process to railroad work.

NEW ARC WELDER AND WELDING WIRE

The H. Kleinhans Company, Pittsburgh, Pa., have recently announced a new motor generator set called the "Mann Welder." The welding circuit of this set consists of a direct current generator with field rheostats and reactance. It is stated by the manufacturers that the generator is so designed that it will produce a flow of constant current and by the use of a small field rheostat in the shunt field circuit the current value may be changed as desired in a large number of steps, from 60 to 200 amperes, and that the length of welding leads can be changed from ten feet to one thousand feet without adjustment. This machine is manufactured in stationary and portable motor generator sets to operate on any type of line characteristics, either direct or alternate current. It is also made in gasoline engine-driven sets for work where electric current is not available. The latter are mounted on either skids or wheels.

The Kleinhans Company is also marketing its own line of welding wire under the trade name of "Uni-Flo" and have endeavored to supply a welding wire suitable for every class of welding work. The "Uni-Flo" line comes in five grades each bearing its own distinctive color. All grades are cut in 14-inch lengths. All coated wires are assembled in five-pound bundles and the five-pound bundles are packed in one hundred and two hundred-pound steel banded, wooden kegs with a sawdust filler to hold the bundles securely in the kegs.

It is reported that the Air Reduction Sales Company of New York have started building a plant at Kansas City, Kansas, for the manufacture of oxygen and acetylene.

A new plant will be constructed on the Belt Line Railroad at Portsmouth, Virginia, by the Portsmouth Oxygen Corporation of that city. It is reported that the new plant will include a welding shop. The president of the corporation is Mr. Louis Rosenstein.

At the April meeting of the American Welding Society, Chicago Section, which was held Friday evening, April 3rd, two very interesting motion pictures were shown, one entitled, "The Applications of Welding and Cutting," was exhibited by Mr. Geo. Rose of the Oxweld Acetylene Company; the second, entitled "The Application of the Carbon Arc to the Welding of Rail Joints," was exhibited by Mr. R. B. Fehr of the Railway and Bonding Company, Cleveland.

On Thursday evening, March 19th, Mr. H. S. Card, Managing Editor of *The Welding Engineer*, made a short talk on the subject of the purpose of welding instruction before the students of the night welding class in Carnegie Institute of Technology, Pittsburgh.

The Master Boiler Makers' Convention will be held at the Hotel Sherman, Chicago, Illinois, on May 19th to 22nd inclusive. The exhibits of the supply men will be held on the mezzanine floor and the business meetings and entertainment will be held in the Tiger Room just above this.

Mr. S. W. Miller will give a talk on "Welding Pressure Vessels" before the Philadelphia Section of the American Welding Society on April 20th.

On March 17th Mr. S. W. Mann of the Kleinhans Company of Pittsburgh read a paper on "Precision Welding" before the Cleveland Section of the American Welding Society. The next meeting of the Cleveland Section is scheduled for April 21st when Mr. Boom of the Boom Boiler & Welding Company will describe some interesting welding jobs.

The Kansas City Oxygen Gas Company has recently moved from 1805 Grand avenue to 2012 Grand avenue, Kansas City.

The Annual Meeting of the American Welding Society has been definitely announced for April 22nd, 23rd and 24th. Sessions will be held mornings, afternoons and evenings on all of these dates. The Annual Banquet is scheduled for Thursday evening at 7 p. m. at the Park Avenue Hotel. One of the interesting features of the meeting is an inspection trip to the Bay Way plant of the Standard Oil Company on Thursday afternoon.

Mr. Fred J. Maeurer of the Engineering Department of the Air Reduction Sales Company, Chicago, has recently been promoted to the distinguished position of grandfather. Estelle Evadne Maeurer is the new daughter of Mr. and Mrs. Harry B. Maeurer. Harry is also connected with the Chicago branch of the Air Reduction Sales Company.

Announcement has been received that the C. H. Hollup Corporation of Chicago took over the direct sale in the Chicago territory of the electric welding wire and accessories formerly sold by the Transportation Engineering Corporation on March 15th. The C. H. Hollup Corporation was formerly the International Welding Engineering Corporation. K. R. Hare, formerly district manager for the Transportation Engineering Corporation, has been retained as sales manager. The plant and general office is at 2001 W. Pershing road and the sales office at 327 S. LaSalle street.

Coincident with the establishing of a welding service department to handle welding rod problems for customers, the Page Steel & Wire Company announces the appointment of J. J. Flaherty to direct sales of Armco, High Carbon and Low Carbon welding rod wire. Mr. Flaherty, who was formerly in charge of welding for the Boston Elevated Railways, will have headquarters at Bridgeport, Conn.

The American Oxygen Service Company is removing its main office from 50 Church street to larger quarters in the new Pennsylvania Building, West 34th street, New York City.

L. B. Allen Company, Inc., 4519-29 North Lincoln Street, Chicago, Ill., have just distributed a series of folders describing their various products including non-acid soldering salts, paste, liquids, alumi-flux, alumi-solder, alumi-weld flux, Allen combination gas-air blow torch soldering and branding tools for use in connection with gas or gasoline. These folders are of interest to all concerned in the welding industry.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address

For Exchange—Welding torch, regulators, and hose, standard makes and in A-1 condition; to exchange or turn in on used Ford runabout or light delivery. Chicago. Address 52, care The Welding Engineer.

Wanted—To get in communication with a good all around Gas Welder who wants to better his condition. There is a part interest in the business awaiting the right man. The present owner had to give up welding on account of poor health. For particulars, write 53 care The Welding Engineer, give your experience in detail.

Position Wanted—Acetylene welder of 10 years' experience desires to make change. Can plan and direct welding operations, both railroad and commercial. Member American Welding Society, Class B. Address A. W. Young, 819 Trimble Ave., Kalamazoo, Mich.

Position Wanted—Expert acetylene welder also electric, desires permanent position with firm of repute. Expert on automobile work, all classes of cylinder and aluminum work. At present employed in charge of largest welding firm in Scotland. Address T. H. Taylor, Foreman, care of Cohy Bros., Parkhead, Glasgow, Scotland.

Position Wanted—Welder, oxy-acetylene, electric and thermit. Three and a half years experience on railroad, shipyard and garage work. Desires connection with firm where ability is appreciated and compensated accordingly. Willing to go anywhere. A-1 references. Address 49, care The Welding Engineer.

Wanted—Used gasoline driven electric welder or generator 2-300 amperes. Give full particulars. Address 50, care The Welding Engineer.

For Sale—Completely equipped acetylene and electric welding shop in town of 8,000 inhabitants, located in the richest farming country and oil fields in the state of Ohio. Priced right for quick sale. Reason for selling, going West. Write for particulars to The Bowling Green Welding Co., 429 E. Wooster Street, Bowling Green, Ohio.

SALESMEN

Wanted—Several aggressive, thoroughly experienced oxy-acetylene apparatus salesmen. The Alexander Milburn Company, 1416-1428 W. Baltimore Street, Baltimore, Md.

Wanted—Used Lincoln or General Electric motor generator set. Must be a bargain. Address Welding Service Company, 631 E. Third Street, Los Angeles, Calif.

Position Wanted—Welding engineer; theoretical; practical; able executive; six years experience gas and electric; sales promotion; instruction; desires change. At present employed in New York. Willing to locate anywhere. Can speak Spanish. Will furnish highest references. Address 51 care The Welding Engineer.

Distributor Wanted for

Autogenous Welding and Cutting Apparatus

Unrivalled in quality, design and price.
Manufactured by large first-class German firm.

Cuts Steel Up to 31 Inches

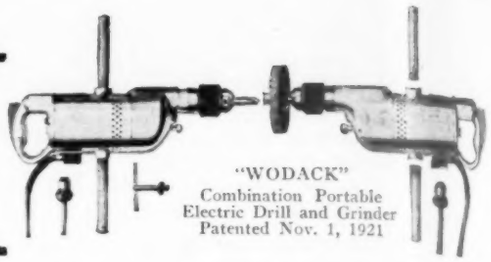
Exclusive agency for importation and distribution will be granted

Write E. W., Box 59, The Welding Engineer

"WHAT YOU NEED IS A WODACK"

The Wodack Combination Portable Electric Drill and Grinder is the best machinery investment a welder can make. It gives you two much-needed tools for the price of one. It gets into the "hard places" and does the work in a jiffy. It prepares your welds and finishes them in fine shape, at low cost. Wodack has been serving the welders for years, and knows what they need. An arc welder salesman recently remarked to a customer, "What you need now is a WODACK." Write for "Electric Drill Facts."

Manufactured by **Wodack Electric Tool Corporation**
43 S. JEFFERSON ST., CHICAGO.



"WODACK"
Combination Portable
Electric Drill and Grinder
Patented Nov. 1, 1921

CURRENT WELDING LITERATURE

ELECTRIC ARC WELDING IN THE STEEL INDUSTRY, by L. W. Warner.—Broken parts can be salvaged with the electric arc and put back in service at a cost below that of a new part. The life of wabblers is increased by building up especially when an outside layer of manganese steel is put on. In the sheet mill there are opportunities for repairing both fractures and worn parts. One of the important operations in the blooming mill is the repairing of gear pinions. In the foundries and furnaces are opportunities to use the arc for fabricating and repair. Maintenance work is also required in the transportation system and the pipe lines. Welding saves the necessity of carrying expensive spare parts. Decreases the cost of replacement and cuts down delays due to breakage.—Journal of the American Welding Society, February, 1925.

SIMPLIFYING THE DESIGN AND CONSTRUCTION OF INDUSTRIAL BUILDINGS, by D. C. McGihn.—The use of the oxy-acetylene process in construction of industrial buildings make possible the elimination of a great many detailed drawings. The steel work of buildings with the exception of trusses and heavy columns can be fabricated on the job. The construction of runways, balconies, stairways, conduits, hoppers, guards, supports, door frames, window frames, etc., are examples of the use of the welding torch in this type of building construction.—Journal of the American Welding Society, February, 1925.

ELEMENTS OF GOOD WELDING, by E. P. Jesson.—Welding is divided into three considerations, equipment, supervision and personnel. The weak spot in the organization is generally found in the supervisory force. The supervisors should be able to choose the metals and method of application, leaving the welder free to concentrate on the actual application. With proper supervision and proper standardization the important requirements of a good operator are that he be obedient and interested in his work.—Journal of the American Welding Society, February, 1925.

SOME INTERESTING REPAIRS.—An interesting series of repairs on fractured air compressor cylinders. These cylinders were preheated all over before welding to avoid the possibility of new breaks either while welding or on cooling. A charcoal and fire brick furnace was the preheating agent. The cylinders were allowed to cool slowly after the repair and the results were perfectly satisfactory.—Revue de la Soudure Autogene, January, 1925.

HOW TO USE THE CUTTING TORCH.—A discussion of the principles of operation of the cutting torch and the methods of making the cut to secure the most satisfactory results and effect the greatest economies in gas consumption.—Revue de la Soudure Autogene, January, 1925.

THE PHENOMENA OF EXPANSION AND CONTRACTION IN REPAIR OF IRON CASTINGS.—A discussion and diagrams showing the expansion effected when castings are heated and describing some simple cases which show how and why expansion and contraction must be provided for when making these welds.—La Soldadura Autogene Y Sus Aplicaciones, January, 1925.

HOW TO WELD ALUMINUM.—The characteristics of some of the various aluminum alloys and a short discussion of welding methods.—La Soldadura Autogena Y Sus Aplicaciones, January, 1925.

WELDING CAST IRON BOILER SECTIONS.—A description of the method used in repairing cast iron boiler sections with illustrations showing how a preheating furnace of fire brick is constructed to take care of the expansion and contraction problem.—La Soldadura Autogena Y Sus Aplicaciones, January, 1925.

THE DESIGN OF SPECIMENS FOR SHORT-TIME FATIGUE TESTS—is the title of Technological Paper No. 275 of the Bureau of Standards, by L. B. Tuckerman, engineer physicist, and C. S. Aitchison, assistant mechanical engineer of the Bureau. It discusses the controlling factors in the design of short-time fatigue test specimens, which differ from those of the endurance-run type of fatigue tests.

THE CAUSES OF CERTAIN FAILURES IN THE WELDING OF MILD STEEL.—A study of the composition and structure of certain materials in which impurities are concentrated at the center during the process of manufacture making it extremely difficult for the welder to do good work. A comparison of good base metal with poor base metal shows that the former does not offer these difficulties to good welding. Simple tests which show nature of the material to be welded can be carried out by simply etching cross sections and using a magnifying glass to see if the physical and chemical structure is uniform.—Revue de la Soudure Autogene, February.

VISUAL CONTROL OF WELDS, by P. Hollard.—Although the outside appearance of a weld does not tell the whole story, good workmanship is roughly indicated by a weld which has sufficient width and reinforcement, which is laid on evenly and which causes no break in the alignment of the plates. It is always worth while to examine the back of a weld as well as the face even though it requires considerable ingenuity to find a method of making such an examination.—Revue de la Soudure Autogene, February.

SWEDOX WELDING RODS, WIRES AND ELECTRODES.—A twenty page booklet issued by the Central Steel and Wire Company, Chicago, describing thirty different varieties of gas and electric welding rods and wire and indicating the nature of the work for which each of these is recommended. Special emphasis is placed on the use of the Testing Laboratory maintained by the company for making critical examination of all welding material before shipment.

RAILROAD WELDING, by A. F. Dillon.—Illustrations and descriptions of the different standard designs of welds with indications of the important uses of each design.—Railway Purchases and Stores, April.

ECONOMIES THROUGH THE USE OF HIGH PURITY OXYGEN IN CUTTING, by John J. Crowe and Geo. L. Walker.—History of the discovery of oxygen and of the developments in oxygen manufacturing methods. Description, charts and tables showing how a series of laboratory and field tests demonstrated the increased efficency of the oxy-acetylene cutting process as the purity of the oxygen used is increased. This paper is followed by a short paper contributed by F. P. Gross describing the procedure followed in analyzing oxygen.—Journal of the A. W. S., March.

ELECTRIC POWER SUPPLY TO THE WELDING INDUSTRY, by Clifford W. Bates.—Details of the costs of supplying electric power service to the welding industry for electric welding, for the manufacture of oxygen and for the manufacture of carbide. Some of the engineering problems involved and how they are dependent upon local conditions.—Journal of the A. W. S., March.

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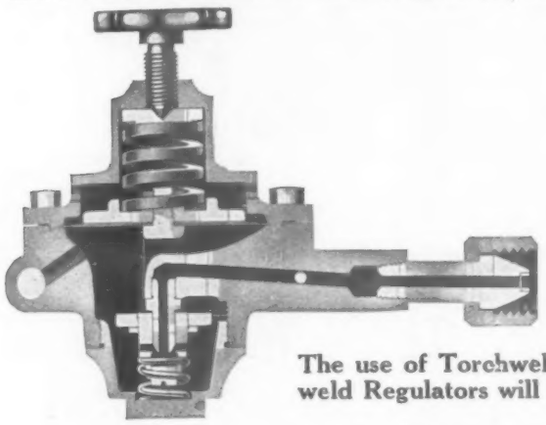

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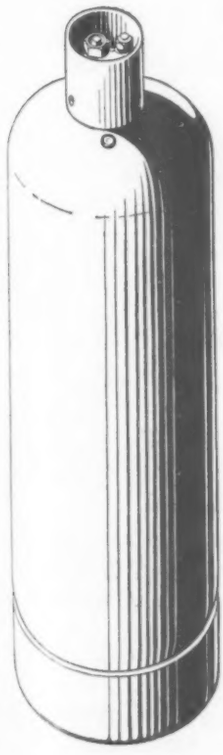

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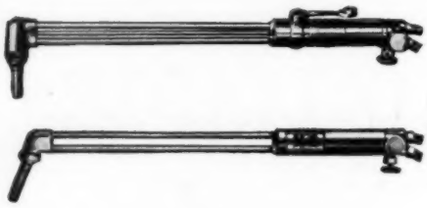

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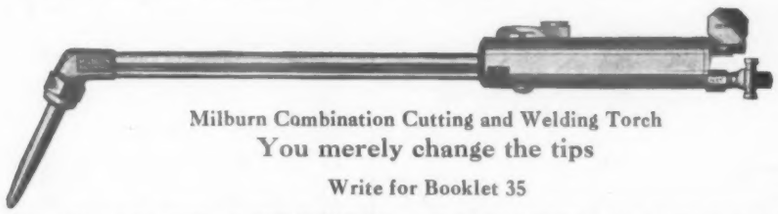

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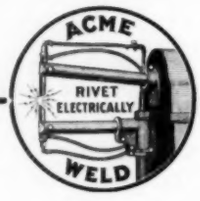

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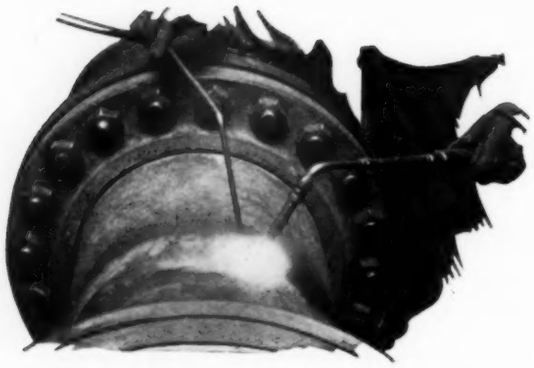

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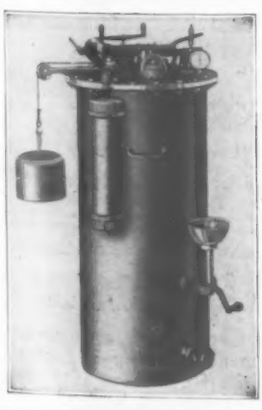

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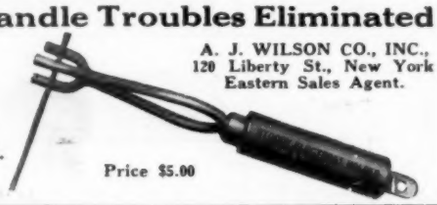

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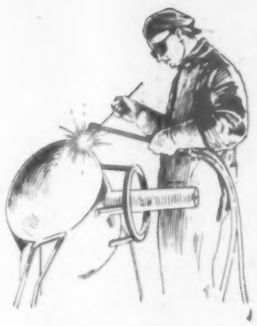

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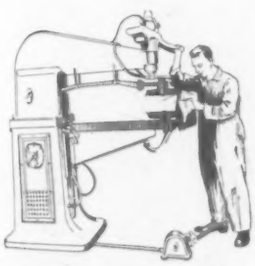

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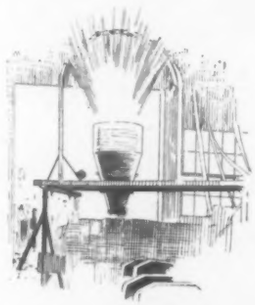

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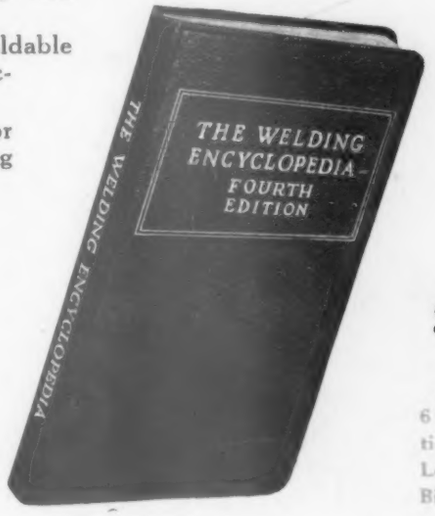

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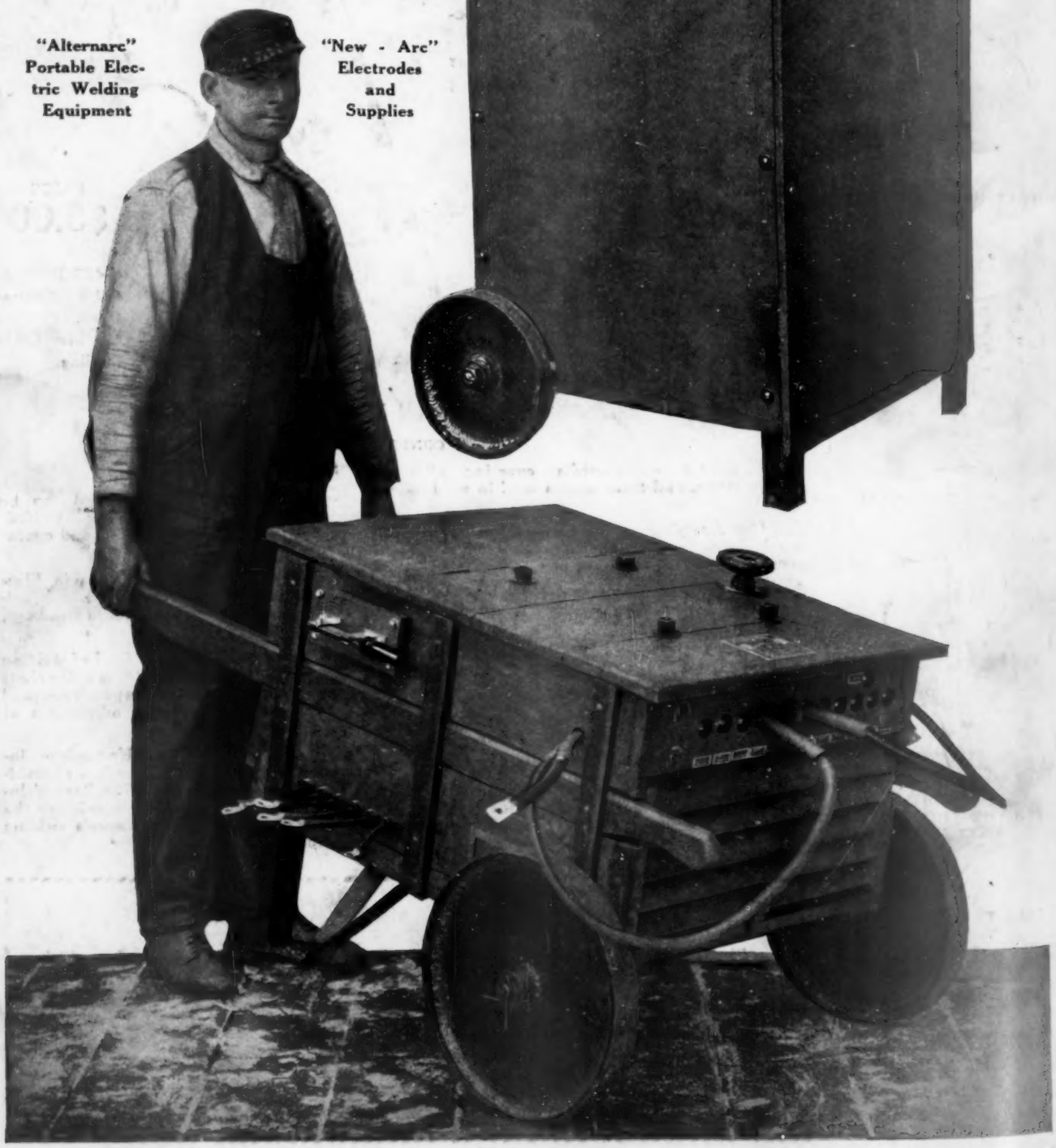
"New - Arc" Electrodes and Supplies